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Contents 131. Advertising Index 51

The Turntable Lathe

With Cross-Sliding Turntable

A Machine for Manufacturing—

hard, rapid, continuous manufacture. It has all the elements that such work requires Solidly fastened stationary head. Spindle always at the same point of operation. Cross-sliding flat, hexagonal Turntable. Accurate and positive stop systems. Powerful all-geared drive delivering the maximum power at all speeds. Massive construction, with weight distributed mathematically correct—fully 30% heavier than any similar machine. An unyielding, unwavering control combined with ease of manipulation and instant response to all operating levers. A degree of accuracy and duplication that does away with all final bench fitting. A tool outfit that is universal in application to meet any manufacturing demands.

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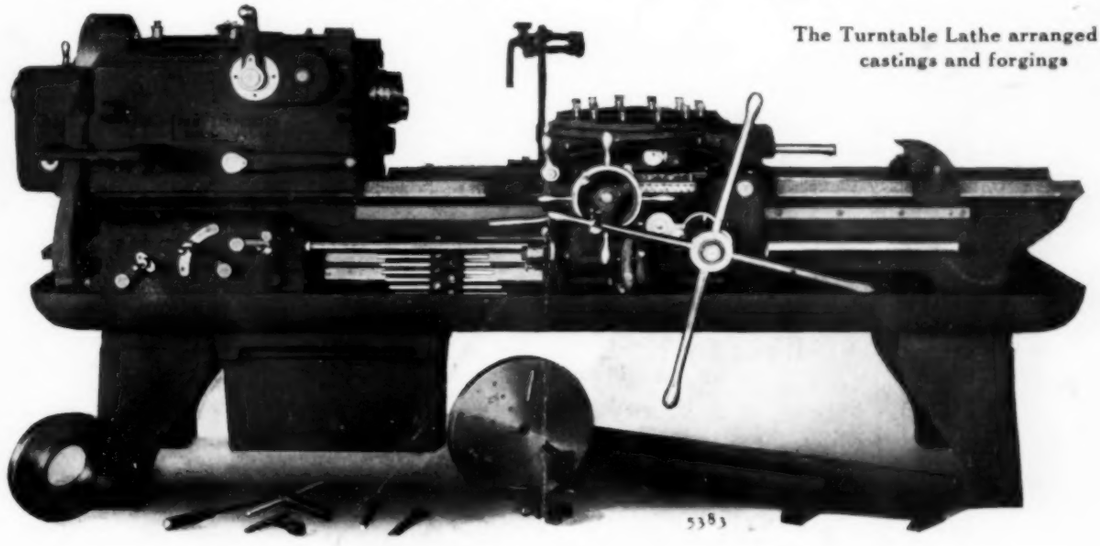
One size. Bar capacity, 2½ x 26 in. Swing, 20 in. Belt or motor drive. Equally efficient on forgings, castings or rod work.

Write for our catalog—The Turntable Lathe—just off the press.



The Turntable Lathe arranged for castings and forgings

Pratt & Whitney Company, Hartford, Conn. U. S. A.

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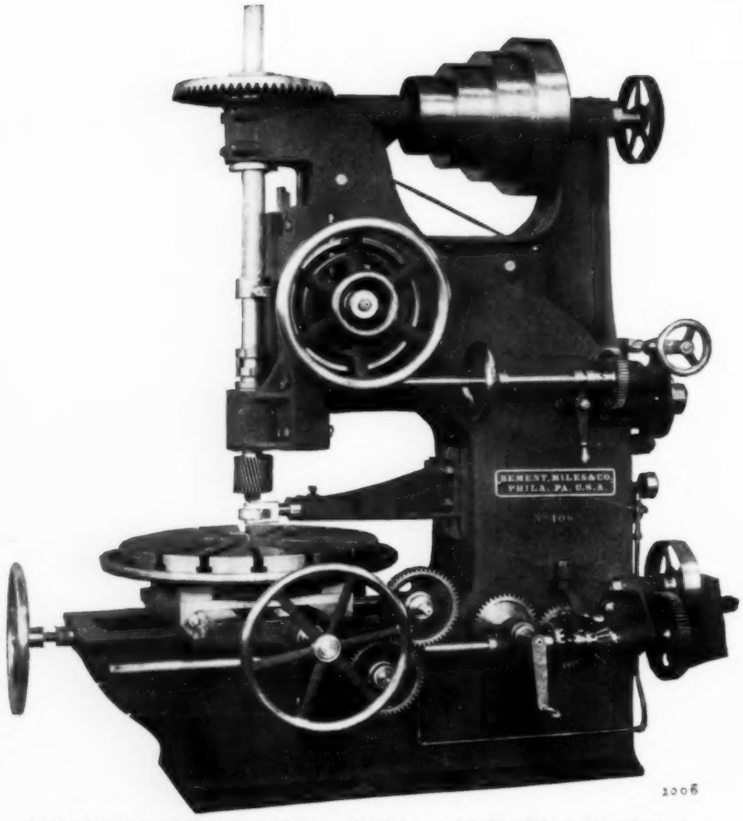
For Milling Cams and Other Irregular Shapes

Bement Vertical Millers



66-inch Bement Vertical Milling Machine with Profiling Attachment.

IT is a difficult proposition to attempt a make-shift operation on your standard miller in hopes of getting out a satisfactory cam shape or other irregular shape.

It will probably take your man a good part of the day to get the machine ready, and he will probably spoil a number of castings until he has obtained the proper adjustments. In the meantime it ties up your standard milling machine that ought to be used to get out the work for which it was intended.

Make-shift operations make exact duplication very difficult. They demonstrate poor economy.

The Bement Vertical Milling Machine with Profiling Attachment can do equally as good work as a special cam cutting machine. And it is not a single purpose machine, such as a cam cutter. It is an invaluable machine for doing a great variety of work impossible on a slotter and cam cutter.

Built in a number of sizes. Belt or motor drive.

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(*See pages* 43, 44, 45 and 46)

Making Auto Motors and Parts

By E. F. Lake

Some methods and machines employed in machining the engine cylinders, piston rods and small levers. Testing for and balancing the flywheels.

Means employed to test the assembled motors, transmissions, rear axles and springs of an automobile.

An example of the modern tendency to insure safety in automobile construction.

The machining operations that are being performed in the automobile shops are continually becoming more interesting. This is largely due to the fact that the factories have grown in size and are turning out cars in such large numbers that considerable time and money can be spent in making jigs and fixtures and buying special machines or tools that will turn out the work more quickly, and hence reduce the cost of production.

The Chalmers Motor Car Company, of Detroit, has shops of this kind, and a large part of the energy expended here is used in testing the various parts, or assembled units, that enter into the construction of the cars. These tests are carried to an extent that will insure the company that the completed car has been placed on the market in a condition that will withstand the wear, tear and strain that such a machine is subjected to.

Machining Cylinders

One of the machine operations seen in this shop is shown in Fig. 1. Here 40 cylinders, cast four *enbloc*, are being machined on three surfaces at one time. The operation is almost a continuous one, as the machine is seldom shut down during the working hours, and then only for a short period.

Before performing this operation, the cylinders had been milled on the top and two sides in this same machine, which is one of Ingersoll's largest milling machines.

To hold the cylinders five separate and distinct jigs, similar to that at *A*, are fastened to the platen of the milling machine and each one of the jigs holds two blocks of cylinders. In starting up in the morning the cylinders at *B* and *C* are clamped in the jigs and the machine is started going. The other three jigs are then filled with cylinders that are secured in place while the machine is running.

When the cutters have moved past the two blocks of cylinders at *B*, and while they are machining the other cylinders, the man with the wrench, at the extreme left of the picture, takes these finished cylinders out of the machine and puts unfinished ones in their place. Thus, it will be seen that this cylinder-machining job is one continuous round of operations, and the only time lost is that of bringing the table of the machine from the finishing back to the starting point.

The large milling cutter *D* faces off the bottom of the cylinders, while cutter *E* is facing off a gland bearing. Another cutter similar to *E* is working on the opposite side, facing off the gland bearings on that side.

In clamping the cylinders in place, the two screws *F* are used to operate the levers *G*. These levers securely clamp the cylinders in position against the back of the jig. The two screws *F*, with their hinged levers are the only parts of the jigs that are moved when taking the cylinders out or clamping them into position.

Drilling and Reaming Piston Rods

The method of machining the piston rods is also interesting, and this is shown in Fig. 2. A four-spindle drill press is rigged up with three jigs for holding the piston rods. Two of these are in use

Fig. 1. Milling Forty Cylinders at One Time

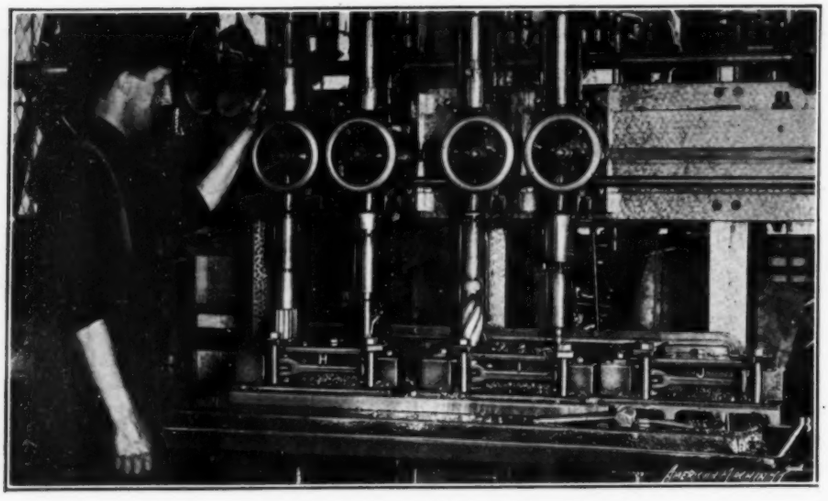


FIG. 2. MACHINING PISTON RODS

for drilling and reaming operations while a finished rod is being taken out of and an unfinished one clamped into the third one. These jigs fit over a guide on which they slide from one position to the other.

In starting up the machine a piston rod is clamped in the jig at *J* and this is slid over to the position *I*. While it is being drilled, at both ends, another jig is having the piston rod clamped in it at *J*. When the drilling operation is finished, the jigs at *I* and *J* are moved over to positions *H* and *I*. The machine then drills both ends of one piston rod and reams both ends of the other. While this is being done another piston rod is being clamped in the third jig; out of which a finished piston rod has been taken at the other end of the machine. In this way the operation is made continuous, as the operator can be removing and clamping up the piston rods while the machine is drilling and reaming them.

One of the machining operations that clearly shows the difference in cost between manufacturing in quantities and manufacturing in small lots is shown in Fig. 3. Here 21 small levers or connections are being milled, in four places at one time, by straddle mills. The finished pieces can be taken out as fast as they are machined and unfinished ones put in their place, so that the operation can begin all over again, as soon as the platen is moved back to the starting point.

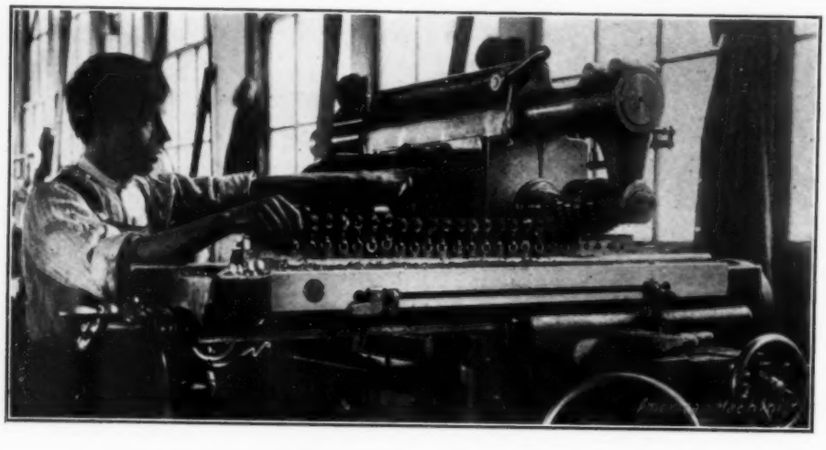


FIG. 3. STRADDLE MILLING SMALL LEVERS IN QUANTITIES

BALANCING FLYWHEELS

In Fig. 4 is shown a Defiance machine used for truing up flywheels, and making them balance perfectly.

The machine proper merely consists of a vertical shaft that is run at a very high speed. On top of this shaft is placed a conical-shaped piece that fits into the center of the flywheel. The flywheel is merely set on this piece and the machine revolved at a very high speed. If it is heavier on one side than the other, that side will be depressed the most so that the flywheel will wabble.

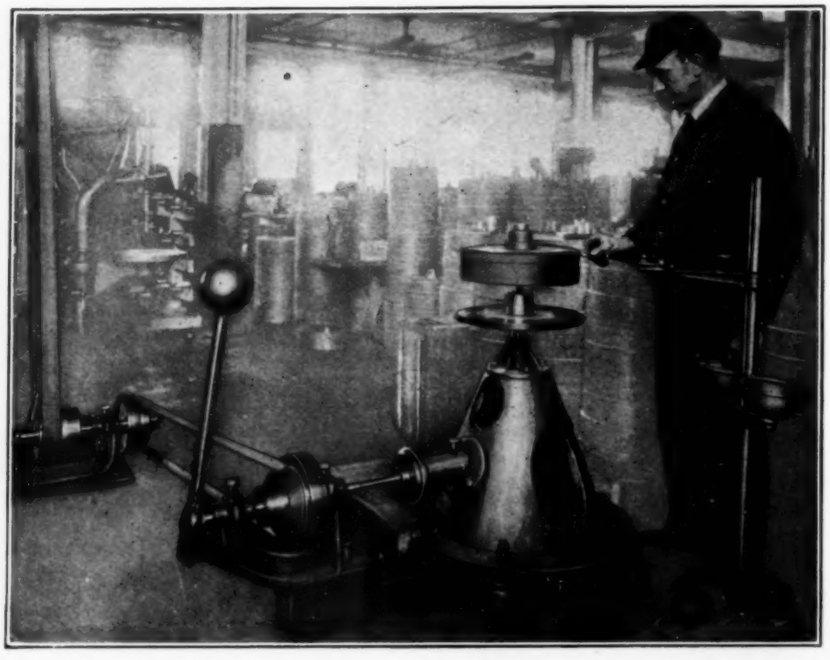


FIG. 4. TESTING FLYWHEELS FOR BALANCE

By using the crayon, from the support, as the operator is doing, the side that is the heaviest is located and enough metal is removed from it to make the wheel run in perfect balance.

With this machine no clamping device is necessary, and the operator only has to lift on and off the flywheels to test them for accuracy. Thus, the work can be quickly done, and it is surprising the number of flywheels that can be trued up in a day's run.

TESTING MOTORS

When the Chalmers motors are completely assembled they are given a block test, as shown by the view of one-half of the testing room, in Fig. 7. The motors are brought into the testing room

with a small hoist that runs on the track shown at *K*. Special castings are used that have four points on which to locate the motor, as shown at *L*. The motors are lowered onto these, by the hoists with which they are brought into the room, and then connected up to the gasolene, cooling water and electricity, as they would be in actual working conditions on the car. The load is applied by attaching the motor's crank shaft to the fan and dynamometer.

The blades of the fan, as shown at *M* and *N*, are 9 inches wide and 18 inches long; the outside diameter of the blades being 36 inches. This fan dynamometer gives a load that increases as the speed of the motor increases until it reaches from 1200 to 1400 revolutions per minute. Beyond this the fans are liable to churn the air and hence cause the applied load to decrease as the speed of the engine further increases.

Transmission Test

The transmission is also given a block test before it is placed in the chassis, to see that all the gears work freely and noiselessly. These are tested under as near working conditions as possible, and a load is applied so that the low-, intermediate- and high-speed gears can be clashed together under the strains and stresses to which they are submitted when in operation on a car. The assembled transmissions and methods of testing them on blocks are shown in Fig. 6.

Rear Axle Test

A test is given the rear axle, as shown in Fig. 5. The complete rear axle with its driving shaft is mounted on the stand shown. The pulleys *O O* are driven by a belt through the floor, as shown at *B*. The rubber tires of the wheels, resting on the pulleys, make the wheels revolve as they should when mounted on a car that is traveling over the road.

The speed of the pulleys is controlled so that the wheels can be given any speed corresponding to that of a motor car traveling at from 10 to 75 miles per hour.

With this test the rear-wheel brakes, the axle, differential gears, bevel driving gear and pinion, and driving shafts can be thoroughly tested, so that the company will be assured that this unit can be relied upon when it is assembled in the completed cars.

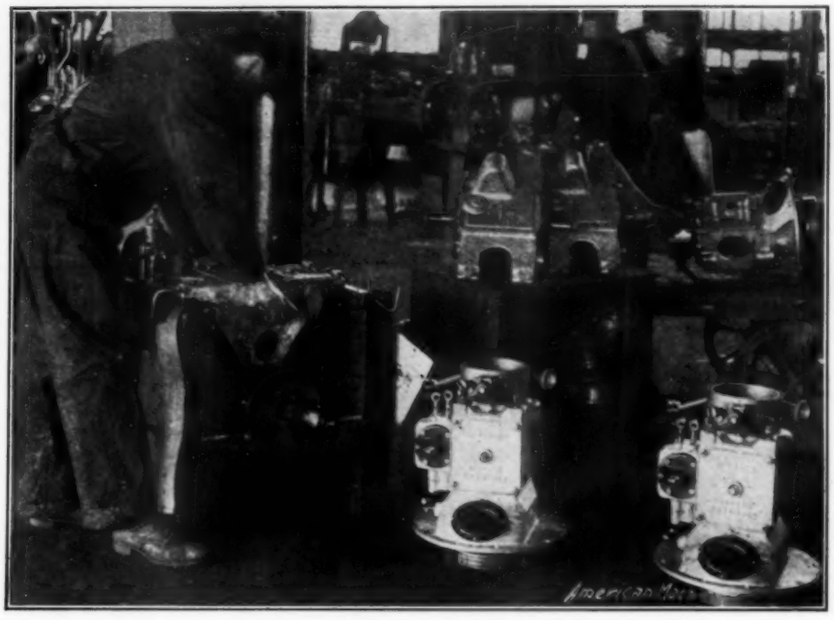


Fig. 6. Block-testing Transmissions

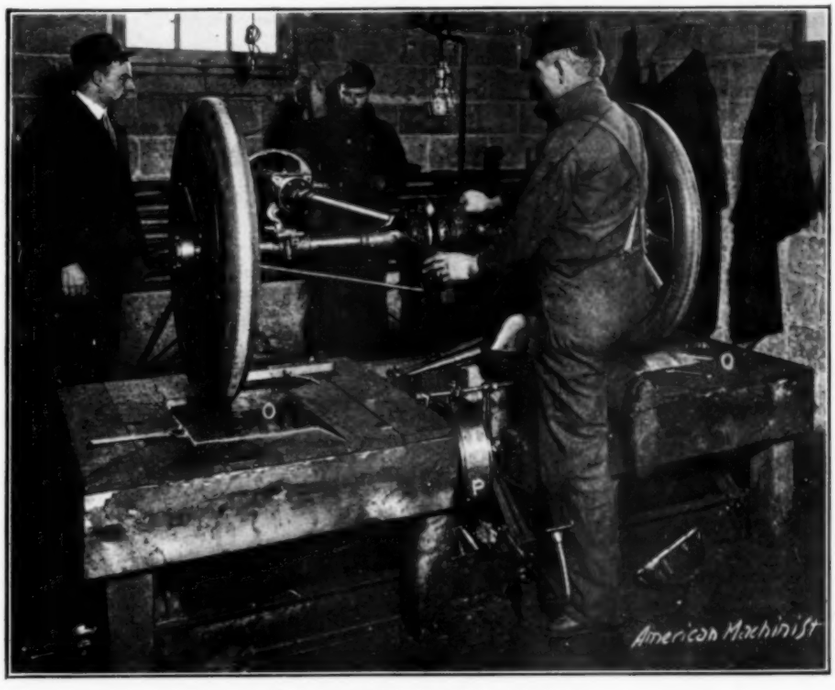


Fig. 5. Testing Rear Axles

Spring Test

Another thing that is of vital interest to the reliability and safety, as well as the easy riding of a motor car, is its springs. This company, therefore, tests each spring, as shown in Fig. 8, before it is located in the car. Here they are given a pressure and resiliency test that is considerably greater than they would need when in actual use on the car, under ordinary conditions. Each spring is then numbered and a record of the test is kept.

These various examples of tests that are made and work that is done on automobiles show the progress that has been made in the past few years in their manufacture. The days have gone by when careless workmanship, or careless selection of materials can be applied to the automobile industry, as the severe strains to which the machine is put are bound to show breakages in various parts that are poorly constructed, and the poorly built car soon gets a reputation that reduces, if not completely destroys its sale.

Special Course in Power and Propulsion

A special course of fifteen lectures, to be given on Wednesday evenings at 6:30 p.m., at the Polytechnic Institute, Brooklyn, N. Y., has been arranged by William D. Ennis, professor of mechanical engineering.

The lectures are to be on power and propulsion, showing the physical principles underlying the determination of resistances to motion in the steam locomotive, automobile, aëroplane and dirigible balloon.

Cutting Bevel Gears

By J. A. Welch

I am submitting what I think is an improvement on usual rotary cutting of miter or bevel gears. The rule I follow and from which I obtain very satisfactory results, is in the case of a 12-pitch miter. I use a 14-pitch bevel cutter, and in the case of a 10-pitch miter use a 12-pitch bevel cutter; this is also true of 9-pitch, but for anything over 9-pitch the result is not good, because of the increased depth of the coarser pitches.

The great prejudice against rotary-cut bevel gears is due to the difficulty of avoiding the backlash in the front of the gears and the bottoming of the teeth because of interference. I recently had a lot of 30-tooth, 12-pitch miters to cut, the cut angle being 42 degrees, the face being 5/8 inch. I used a 14-pitch bevel cutter No. 3 and set the edge of the cutter on the center and tilted the head to 40 degrees 30 minutes, and cut them at a depth of 0.173 instead of 0.180. I made one cut around the gears, and then set the other edge of the cutter on the center, and thinned the teeth to the proper thickness. The gears set square, and rolled very smoothly without interference, showing contact on the pitch line for full length of the tooth.

Now, in the case of bevel gears where it does not pay to plane them, say, from 16-pitch to 9-pitch, and where the ratio is two to one, and over. I had some four to one bevels. 16-pitch, 64 and 16 teeth, 1/2-inch face, that when cut in two cuts had so much interference that they jumped in running. I then cut the gear with a No. 3, 16-pitch bevel cutter which made the tooth quite round, and I cut the pinion with an 18-pitch, No. 7 spur cutter, at the regular 16-pitch depth which made a very satisfactory job.

I had a similar experience with some two to four bevels, 10-pitch, 40 and 20 teeth; for the pinion I used a No. 6, 12-pitch spur cutter, cut them at the regular angle, and 10-pitch depth. For the gears I used a 10-pitch bevel cutter, No. 4, and thinned the tooth to suit the pinion, there was no interference, and had a bearing the full length of the tooth. The same rule applies on 12-pitch bevels, that is, use a 14-pitch spur cutter on the pinion, and a 12-pitch bevel cutter on the gear.

I have found that on miter gears up to 9 pitch, you should use a bevel cutter, two pitches under that called for by the number of teeth and pitch diameter.

Fig. 7. One Side of Room for Block-testing Motors

Cement Age and Concrete Engineering Consolidated

Cement manufacturers, architects, engineers and contractors will be interested in the announcement that *Cement Age,* of New York, and *Concrete Engineering,* of Cleveland, two of the leading monthly publications in the cement field, have been consolidated. Beginning with the January, 1911, issue, the two magazines will be consolidated under the title: *"Cement Age,* with which is combined *Concrete Engineering."* The magazine will be slightly larger than the present size of *Cement Age.*

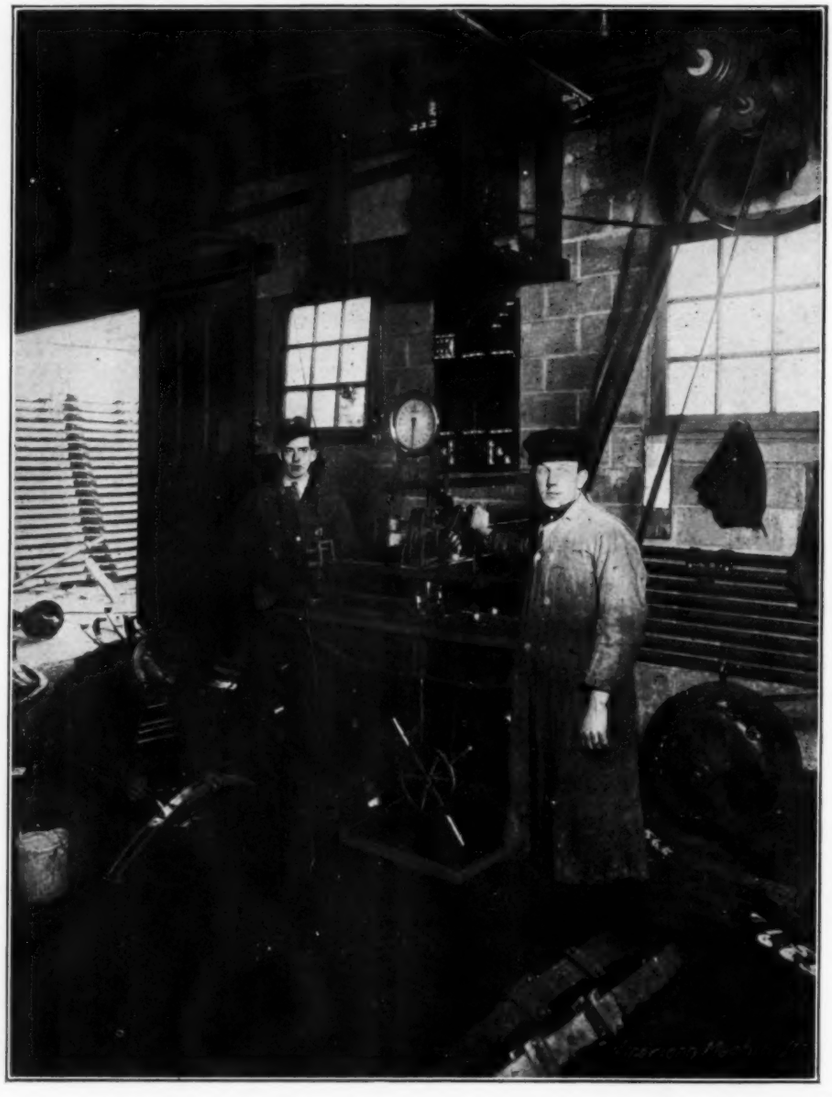


Fig. 8. Giving Springs the Pressure and Resiliency Tests

Notes on Making Sheffield Cutlery

By A. L. Haas

Primitive hand methods are still used in making the best grades of cutlery, such as are known in all markets of the world. Traditions are strong. In some places tanks of hardening brine said to be over 100 years old are valued at $1000 each.

In the making of high-class cutlery the methods and processes are to the eye of an engineer primitive, since the majority of these are unaided hand work. Less expensive goods are largely machine made, though grinding is still hand work. Even quite small pocket-knife blades are made on the anvil with the aid of a tapered block, and the assembling of blades and scales, as the handles are termed, is purely hand work.

Ruskin, who detested the modern innovation of machine processes and the growth of the factory system, took quite a paternal interest in Sheffield because of the survival of pure handicraft, which to this day is still in evidence.

In the making of a high-class table knife, a piece of 1x⅛ inch flat double-shear steel is welded to a bar of iron sufficient in size to make the bolster or shoulder, which is then shaped in hand dies on the anvil. The tang or handle part is then drawn down to size, and the blade drawn tapering from bolster to point, and from back to edge by simple hammer manipulation on the anvil. The blade after hardening is sent to the grinder to finish.

Razor blades are hand forged from crucible carbon steel with a high carbon content and very fine fracture, a bar 1 inch or 1⅛ inches square being drawn down on the anvil under sledge blows to the requisite size, thus further refining the grain of the steel.

The machine-made table knives are made from bessemer steel, the bar being sufficient in size to fashion the bolster. This is formed by drop dies and the blade and tang drawn out under a coach spring hammer between tapered blocks.

Comparing the two types of cutting edge produced, the double shear steel rolled nearly to size gives a coarser and rougher edge, the fracture of the steel being granular, large in grain and irregular in texture. As comparatively little forging is done to the blade the original structure of the steel is preserved, and an edge peculiarly suitable to cut food is the result.

On the other hand the bessemer steel being more regular and finer in grain, and being forged down from ⅝ inch to knife size, has a finer and closer texture imparted to it under the hammer and has consequently a finer edge, not so suitable for cutting food. From household experience a hand-made shear-steel carving knife is a much superior tool and is preferred by any user.

A close inspection of a high-class hand-made knife when quite new will show two lines in the lengthwise direction of the blade. These are the welds made in the billet which persist when welded and rolled into bar and never entirely disappear. At the junction of blade and bolster, the characteristic thumb mark of the weld is clearly shown.

One of the most interesting jobs in the making of a table knife, from a mechanic's point of view, is the drilling of the handle, whether of ivory or celluloid. The piece of material to form the handle has a cross-section of ⅝x⅜ inch and has a hole drilled to take the tang of blade, 5/32 inch in diameter drilled lengthwise, and in the case of celluloid stopping within 1/32 inch from the end. The handle is spoiled if, when the tang has been inserted and the knife finished, the opacity of the handle is spoiled by the tang showing as a dark line on one side.

The process of drilling demands considerable skill. On the edge of the rather low bench two forked pieces of steel are set up and a long drill having a bobbin to take a 1-inch belt, the drill itself being its own spindle in the bearings afforded by the forks. The driving shaft is below the bench so that the belt pull is downward. The drill is of the ordinary flat type with included angle of cutting edges about 80 per cent., and the facets are much sharper than a similar drill for metal.

The cutter takes the blank handle on his knee and placing his hand over the blank moves both leg and hand toward the point of drill, which revolves about 1500-2000 revolutions per minute, and sinks the drill point about ½ inch and withdraws the blank, reverses the position of blank (turns it over), and after moistening the point of the drill with oil, drills a further ½ inch. This process is repeated until the correct depth is obtained.

The hole when finished shows a series of steps at each ½ inch down, but the hole comes central and true. It is pure hand and eye guidance, brought by practice to a fine art. It is unusual to have more than one waste out of a gross, and the cutter can drill a gross an hour.

Drilling by machine has been tried but has been abandoned, owing to the number of wasters produced.

Ivory handles are pinned through the side or washered at end of the tang to secure the blade.

Celluloid becoming elastic at the temperature of boiling water, the handles are immersed for some minutes and driven onto the tang, which has been previously roughened, and a properly fitted celluloid handle never comes loose in use.

The price paid for the steel varies, naturally, as the quality of the knife. Steel for razors varies from 25 shillings ($6.25) to 60 shillings ($15) per hundredweight. There is a special brand made by one steel house which costs 84 shillings ($21) per hundredweight.

The shops in which the hand-made knives are forged rarely contain more than two fires. In a large firm there is a conglomeration of these tiny shops adjoining. The fires used are about the size of a large teacup and hand bellows for blast are universally employed.

In spite of the seemingly primitive methods employed, really high-grade cutlery and razors made in Sheffield are sold in every market in the world in spite of the highest tariff. There is something in inherited skill after all. Grandfather, father and son in numerous instances are working at the same time for one firm.

Value of Brine

In conversation with the senior partner in one of the best known Sheffield firms, I learned that in the valuation of the premises the contents of the brine tank, used to harden files, was valued at £200 ($1000). I expressed some amusement. He told me that the water had not been emptied for over 100 years and that probably, if by some accident the contents were emptied, the wasters in hardening would increase alarmingly. His men would attribute the wasters entirely to fresh water.

While the above statement is true as related, I have no such faith in the virtue of old water and believe the conditions of the industry favor the handing down of tradition from generation to generation. Probably in the first instance, before the action of globules of air in water when hardening was understood, it was found that repeated immersions of hot metal in the hardening water gave better results and the results were attributed to the age of the water, and so handed down to this enlightened Twentieth century.

Fixtures for the Vacuum Cleaner

Some of the fixtures used by the Keller Manufacturing Company, of Philadelphia, in the making of their vacuum cleaning machines, are shown in the accompanying halftones.

Turning of a double eccentric for a vacuum cleaner having two pistons moving in opposite directions, is shown in Fig. 1. Piece *A* shows the result of the first operation, this having been done in an adjustable, offsetting chuck. After this, *A* is put into the fixture *B*, with the center hole over the bolt and with the completed eccentric fitting into the eccentric recess around this bolt.

Careful observation of the circular tool marks on the face of *B* will show that the bolt is not in the true center, but is eccentric to the amount of eccentricity required. Then, when *A* is mounted upon the bolt, with the first, already formed eccentric in the recess, turning in the lathe will produce the other eccentric directly opposite the first one. The front portion of *B* is adjustable upon the face plate *C*, so that the eccentricity may be varied if desired.

Getting the proper relief in shaping die blocks usually is accomplished by a more or less troublesome operation of adjusting the block in the shaper vise. A much better way to do this is shown in Fig. 2, where the two strips *B* and *C* are made in the wedge shape, so as to give at once the correct angle to the piece operated upon. Of course, the outside faces of *B* and *C* are at right angles to the bases; but the inner faces are at the required angle.

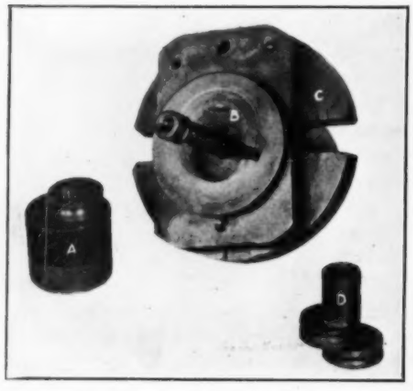


FIG. 1. TURNING A DOUBLE ECCENTRIC

In the same illustration is also shown a homemade "patent" tool holder, carrying a long, high-speed steel tool point for shaping through the die block; the idea being to do away with the objectionable, springing, goose-necked tool. Another view of this tool holder is shown at *A*; while *D* is the yoke, with nut, which clamps the tool holder to the tool block.

Eccentric boring is shown in Fig. 3. Piece *A* is a brass casting which is used in a hand form of vacuum cleaner manufactured by the same firm. It is necessary to accurately bore out the two, small, diametrically opposite holes *H* and *H'*, on each side of *A*. This is done by mounting the fixture *C* eccentrically upon the faceplate. Fixture *C* itself is made with a shank and may swivel about its own center; so that first one, and then the other of the cored holes *H* and *H'* may be brought upon the center of the lathe. Yokepiece *F*, which is held in the lathe turret, is used for the first location of the rough casting in the fixture *C*. Nurled collars *D* and *E* are screwed together so as to hold the casting rigidly in the fixture *C*. *C* is, of course, held in any one position relative to the faceplate by a pin at the back of the latter. The finished piece is shown at *B*.

It should be remarked in passing, that the turret lathe used for this operation was made in the Keller shop by remodeling an ordinary engine lathe. This will be recognized by the carriage and slide rest shown in the foreground.

Turret lathe work in an engine lathe is also shown in Fig. 4, where there are two tool posts coupled together and mounted upon the same cross slide. Referring to the illustration, the tool on the left is for facing, and the one in the distance, at the right, is for boring. Toward the lower right-hand corner of the illustration will be noted the coupling bar which holds the two tool blocks at a definite distance apart.

Facing and boring are not performed at the same time, as the tools are too close together, and, of course, the lathe has to be reversed for cutting with the boring tool, as it is back of the center. The two tools are, however, set at the correct angles to do their work upon the castings as they are mounted in the chuck, without adjustment.

Editorial Correspondence

Offsetting, recessed chuck for turning double eccentrics.

Wedge blocks for the shaper vise to give the correct relief when shaping dies. Homemade shaper tool holder.

Reversing fixture for eccentric boring in the lathe.

Two tool blocks coupled together, to hold two tools for consecutive operations in the lathe.

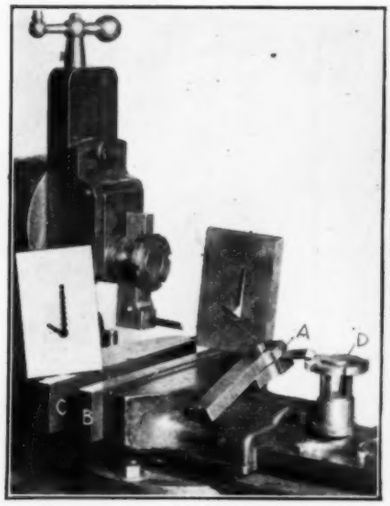


FIG. 2. WEDGE BLOCKS AND SPECIAL TOOL FOR SHAPING DIES

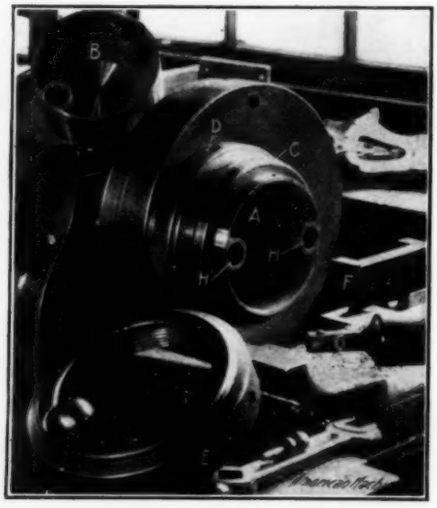


FIG. 3. FIXTURE FOR OFF-CENTER BORING

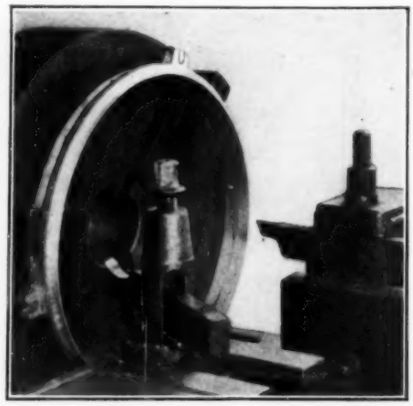


FIG. 4. DOUBLE TOOL HOLDER FOR CONSECUTIVE OPERATIONS

Hobbing Helical or Spiral Gears

Special Correspondence

Instructions for setting up and running the Gould & Eberhardt gear hobber.

While hobbing machines differ somewhat in construction the general principles are the same and many of the suggestions will apply to any machine.

The Helical Gear Chart shown herewith, is furnished with each machine, giving the necessary formulas to arrange the machine for cutting helical gears.

Before cutting any helical gears two calculations for the proper change wheels must be made in accordance with the formulas given on the charts; one of which is for the number of teeth and angle to be cut, and the other for the amount of feed.

The formula for the number of teeth and angle is

$$\frac{60\,C}{N\,C-1}=\frac{Driver}{Worm}$$

in which C equals a feed constant, selected from the Table of Feed Constants, and dependent upon the pitch and angle of the gear, and the required feed.

Problems Worked Out

Taking the example given on the chart: A gear 71 teeth, $6\,P^{nd}$, 45 degrees, feed 1/16 inch per revolution of blank:

The feed constant C is found by entering the table with the pitch $6\,P^{nd}$ and the angle 45 degrees, and then in the column of 1/16 feed the value 12 will be found.

Taking another example, for instance 72 teeth, $6P^{nd}$, 45 degrees, feed 1/16 inch per revolution of blank, the ratio will be:

$$\frac{60\times 12}{(72\times 12)-1}=\frac{720}{863}$$

in which 863 is a prime number. The procedure in such a case would be to change the feed constant as for example:

$$\frac{60\times 11\frac{3}{4}}{(72\times 11\frac{3}{4})-1}=\frac{141}{169}.$$

The formula for the feed is $\frac{16\,P^{nc}}{C\ sin.\ X}$ in which C must correspond to the constant used in the formula for the teeth and angle, for instance the example given on the chart:

$$\frac{16\times 0.5236}{12\times 0.70711}=0.98730.$$

Using the Tables

To facilitate the calculation of this formula, a multiplication table is found on the chart giving the product of the fixed constant, 16, multiplied by the various pitches. After the decimal has been obtained for the feed, the nearest fraction can be found in the table of decimal equivalents, as for instance, in the above example, the nearest fraction is

$$\frac{78}{79}=0.98734.$$

To prove the correctness of the calculation a proof formula is given on the chart, to wit:

$$\frac{16\,P^{nc}}{V\,C\ sin.\ X}=1.$$

The result of the proof formula approximates 1, either plus or minus, depending upon the hand of the gear being cut, whether right or left. Note the similarity between the proof formula and the feed formula to avoid unnecessary calculation.

The proof formula need not ordinarily be used to get within the limits given for the variation, namely: 1.001 or 0.999 except for comparative errors.

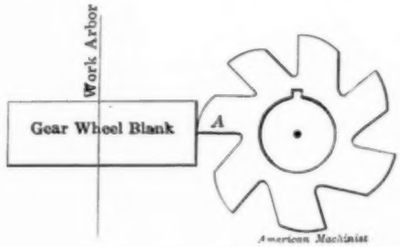


Fig. 1. Hob in Position

Finding the Actual Error

However, if the actual amount of error is desired, it will be advisable to go one step further and find the actual amount of deviation, of the resultant, from the true helix, for one inch face, by the formula $E\ tan.\ X$, in which E is the difference between 1 and the result of proof formula; an example whereof is given on the chart.

After the necessary calculations have been made, the change gears are all placed in position on the rear of the machine according to the diagrams on the chart.

The change gears having all been placed in position, the hob cutter is mounted upon and secured to the arbor. However, before securing the cutter the end bearing should be in place.

Setting the Cutters

A cutter space is then set centrally by means of the gage furnished. To do this the spindle-bearing bolts are loosened and the bearing adjusted endwise until the gage shows the space central. The spindle bearings are then secured again.

The swivel slide is then adjusted to the proper angle. This angle is obtained by subtracting the angle of the hob from the angle to be cut on the gear. The Spiral Gear Chart must be consulted to obtain the proper direction in relation to the perpendicular which depends upon whether the gear is right or left hand. The swivel slide should then be securely fastened again.

Right-hand cutters should be used to cut right-hand gears. Left-hand cutters should be used to cut left-hand gears.

The gears to rotate the cutter in the proper direction are then engaged by means of a handle on the pulley side of the machine.

To obtain the downward direction of the feed, the proper tumbler gears must be engaged by means of the handle on the side opposite the pulley.

The work mandrel is then inserted in the work table and the blank securely fastened thereon. Care should be taken that the hole and faces of the blank by which it is clamped are entirely free from all dirt and burs, and that the blank is of the proper diameter.

The outer support arm is placed in position and the wheel blank is then tested by an indicator to see whether its outer periphery revolves perfectly true with the hole. The revolving of the blank is accomplished by merely starting up the machine with the belt on the fastest speed, or by disengaging the worm and revolving the work table by hand.

Work Must Revolve True

It is very important to have the blank revolve true to obtain good results in the running of the finished gear.

After the wheel blank has been found correct, the cutter is lowered so that the center is below the upper edge of the blank. Care must be taken that the radial faces of one row of cutting teeth are parallel with the center line of the spindle. They should be at their highest point in relation to the face of the wheel blank. This is shown in Fig. 1, where the radial face A just touches the blank and is parallel to the cutter spindle.

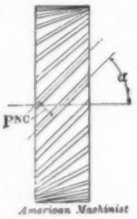
The blank is then adjusted by means of the horizontal screw, operated by the crank handle, until the periphery of the blank just touches the top of the cutting teeth.

The cutter is then raised above the face of the blank and adjusted to the proper depth to be cut. A dial is provided upon the screw to read in thousandths, which is set to zero after the cutter has been raised. The proper depth can then be read when the blank is adjusted toward the cutter.

HELICAL GEAR CHART FOR AUTOMATIC SPUR AND HELICAL GEAR GENERATING MACHINE.

Notation.

N = Number of teeth to be cut;
C = Feed constant selected from table;
PNC = Normal circular pitch of gear;
PND = Normal diametral pitch of gear;
a = Addendum of tooth;
α = Angle of helix with the axis;
β = Angle marked on helical cutter;
ϕ = Angle to set cutter.



Formulas to Calculate Helical Gears.

$$\text{Pitch diameter} = \frac{N}{PND \cos.\ \alpha} \text{ or } \frac{N a}{\cos.\ \alpha}.$$

$$\text{Outside diameter} = \text{pitch diameter} + 2a.$$

Formulas to Gear Up Machine.

For number of teeth and angle

$$\frac{60\,C}{NC - 1} = \frac{driver}{worm}.$$

For feed gears

$$\frac{16\,PNC}{C\ sin.\ \alpha} = \frac{drivers}{driven} = V.$$

Proof formula

$$\frac{16\,PNC}{VC\ sin.\ \alpha} = 1 \longleftarrow limits\ 1.001 - 0.999.$$

Error of *tan.* per inch

Equals E *tan.* α

in which E is the difference between 1 and the result of the proof formula.

Example.

Gear 71 $T - 6\ PND - 45°$.
Feed $\frac{1}{16}$ inch per revolution of blank.

$$\frac{60 \times 12}{71 \times 12 - 1} = \frac{720}{851} = \frac{48 \times 30}{46 \times 37}.$$

$$\frac{16 \times 0.5236}{12 \times 0.70711} = 0.98730.$$

Gears $\frac{60 \times 78}{60 \times 79} = 0.98734.$

$$\frac{16 \times 0.5236}{\frac{60 \times 78}{60 \times 79} \times 12 \times 0.70711} = 0.999963.$$

1.000000
0.999963 *Tan.* 45° = 1.
0.000037 = E.
0.000037 × 1 = 0.000037 = *Error of tan. per inch.*

CHANGE GEARS—24 to 97 teeth, inclusive 2-24, 3-30, 3-40, 2-45, 5-60, 2-80, 2-90, and 2-96; 87 gears in all.

TABLE OF FEED CONSTANTS

PND	4		5		6		7		8		9		10		12		14		16		18	
PNC	0.7854		0.6283		0.5236		0.4488		0.3927		0.34906		0.31416		0.2618		0.2244		0.19635		0.17453	
Feed per rev. blank	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$
Angle α.	Value of C.																					
10°	54	72	43	58	36	48	31	41	27	36	24	32	22	29	18	24	16	21	14	18	12	16
11°	49	66	39	53	33	44	28	38	25	33	22	29	20	26	17	22	14	19	12	16	11	15
12°	45	60	36	48	30	40	26	34	23	30	20	27	18	24	15	20	13	17	11	15	10	14
13°	42	56	33	45	28	37	24	32	21	28	19	25	17	22	14	19	12	16	11	14	9	13
14°	39	52	31	42	26	35	22	30	20	26	17	23	16	21	13	17	11	15	10	13	9	12
15°	36	49	29	39	24	32	21	28	18	24	16	22	15	19	12	16	10	14	9	12	8	11
16°	34	46	27	37	23	30	20	26	17	23	15	20	14	18	11	15	10	13	9	11	8	10
17°	32	43	26	35	22	29	18	25	16	21	14	19	13	17	11	14	9	12	8	11	7	10
18°	30	41	24	33	20	27	17	23	15	20	14	18	12	16	10	14	9	12	8	10	7	9
19°	29	39	23	31	19	26	17	22	15	19	13	17	12	15	10	13	8	11	7	10	6	9
20°	28	37	22	29	18	25	16	21	14	18	12	16	11	15	9	12	8	11	7	9	6	8
22°	25	34	20	27	17	23	14	19	13	17	11	15	10	13	8	11	7	10	6	8	6	7
24°	23	31	18	25	15	21	13	18	12	15	10	14	9	12	8	10	7	9	6	8	5	7
26°	21	29	17	23	14	19	12	16	11	14	10	13	9	11	7	10	6	8	5	7	5	6
28°	20	27	16	21	13	18	11	15	10	13	9	12	8	11	7	9	6	8	5	7	5	6
30°	19	25	15	20	13	17	11	14	9	13	8	11	8	10	6	8	5	7	5	6	4	6
35°	16	22	13	18	11	15	9	12	8	11	7	10	7	9	5	7	5	6	4	5	4	5
40°	15	20	12	16	10	13	8	11	7	10	7	9	6	8	5	7	4	6	4	5	3	4
45°	13	18	11	14	9	12	8	10	7	9	6	8	5	7	4	6	4	5	3	4	3	4
50°	12	16	10	13	8	11	7	9	6	8	6	7	5	7	4	5	4	5	3	4	3	4
60°	11	15	9	12	7	10	6	8	5	7	5	6	4	6	4	5	3	4	3	4	2	3
70°	10	13	8	11	7	9	6	8	5	7	4	6	4	5	3	4	3	4	2	3	2	3
80°	10	13	8	10	6	8	5	7	5	6	4	6	4	5	3	4	3	4	2	3	2	3

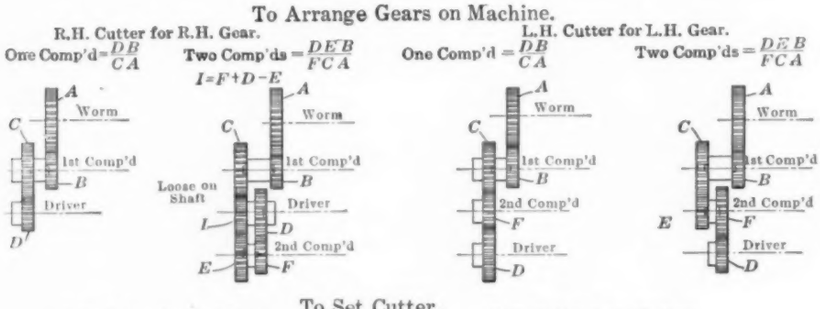
TO FIND C FOR DIFFERENT FEEDS.

Feed.	How Obtained.
$\frac{1}{24}$	Multiply C for $\frac{1}{12}$ by 4.
$\frac{1}{32}$	Multiply C for $\frac{1}{16}$ by 4.
$\frac{1}{24}$	Multiply C for $\frac{1}{12}$ by 2.
$\frac{1}{32}$	Multiply C for $\frac{1}{16}$ by 2.
$\frac{1}{12}$	Same as table.
$\frac{1}{16}$	Same as table.
$\frac{1}{6}$	Divide C for $\frac{1}{12}$ by 2.
$\frac{1}{8}$	Divide C for $\frac{1}{16}$ by 2.
$\frac{1}{4}$	Divide C for $\frac{1}{12}$ by 3.
$\frac{1}{4}$	Divide C for $\frac{1}{16}$ by 4.

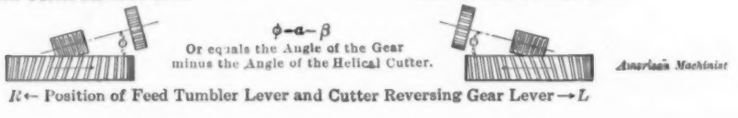
MULTIPLICATION TABLE.

PD.	PNC.	$16 \times PNC$	PD.	PNC.	$16 \times PNC$.
4	0.7854	12.5664	10	0.3141	5.0265
5	0.6283	10.0531	12	0.2618	4.1888
6	0.5236	8.3776	14	0.2244	3.5904
7	0.4488	7.1808	16	0.1963	3.1416
8	0.3927	6.2832	18	0.1745	2.7924
9	0.3490	5.5851			

To Arrange Gears on Machine.



To Set Cutter.


R.H. Cutter for R.H. Gear.
φ = α − β
Or equals the Angle of the Gear minus the Angle of the Helical Cutter.
L.H. Cutter for L.H. Gear.
American Machinist

R ← Position of Feed Tumbler Lever and Cutter Reversing Gear Lever → L

HIGH SPEED CUTTERS.

65 Feet per Minute for C.I. and 45 Feet per Minute for Steel.

PD.	4	5	6	7	8	9	10	12	14	16	18
Outside Dia.	$3\frac{1}{2}$	$3\frac{1}{2}$	3	$2\frac{7}{8}$	$2\frac{7}{8}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{4}$
R.P.M. C. I.											
R.P.M. Steel											

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When the work blank has been adjusted to the proper depth, the work table is secured to the base by means of the clamping screws.

The proper speed for the cutter is then ascertained from the Spiral Gear Chart and the belt placed upon the proper cone step in accordance therewith.

The machine can then be started and the cutter fed to the upper edge of the work by means of the hand wheel and the feed engaged by the handle near the pulley. The machine will then automatically generate all of the teeth of the gear.

A Caution about Stopping the Feed

The dog upon the vertical feed rod should not be set as in squr-gear cutting, because if the feed is disengaged before the cutter is entirely clear of the work, the gear would be spoiled by having its teeth milled away. When the center of the cutter has about passed the lower edge of the blank, the operator must stop the entire machine, then withdraw the work from the cutter and raise the cutter if he wishes to take another cut. If, however, the gear is completed, the work can be raised without withdrawing the work slide and the cutter raised before inserting a new blank.

The setting of the wheel blank for depth should be done as outlined for spur gears, that is, for chordal thickness.

Whenever the cutter is raised, in cutting helical gears, the blank must first be withdrawn from the cutter and then adjusted for the extra depth. The raising of the cutter also necessitates the resetting of the helices with relation to the cutter.

Taking a Second Cut

It is frequently necessary to take a second cut in helical gears in order to obtain the correct thickness of tooth, or there may be other reasons for wishing to recut the gear. The machine can be set to recut helical and spiral gears without losing the lead, in the following manner:

When the machine has been properly set to commence cutting and the feed clutches are engaged, the work table should be set to the zero line provided on the work carriage, by means of the zero indicator arranged to fit one of the T-slots in the work table.

The dial on the driver shaft near the hand wheel is then set to its zero mark and the position of the cutter slide located by means of the zero lines.

The zero indicator in the work table can then be removed and the machine started. When the gear has been cut and it is desired to return the cutter from any position for a recut, it is only necessary to return the machine to the above zero points, which can be done as follows:

The machine is stopped and the work carriage withdrawn from the cutter so that the cutter can be raised to its original position, indicated by the zero lines on the pulley side of the machine. The machine is then operated by a crank handle until the zero indicator of the work table, which must be replaced, approximately matches the zero line on the work carriage, and the zero lines on the driver shaft exactly match.

The zero indicator in the work table is then accurately adjusted to match the zero line on the work carriage by means of the micrometer adjusting device arranged on the index worm. The feed clutches are then engaged, but care should be taken that the zero lines on the slide are correctly maintained. The work can then be adjusted to the proper depth and the machine started to cut again.

Gage for Testing Feed Rolls

By S. N. Bacon

The gage shown in the attached sketch was designed for testing the diameter and concentricity of a hard-rubber feed roller used on printing machinery. The roller consists of a hollow-steel core with journals at each end, and rubber about ⅛ inch thick is vulcanized on, and ground to an exact diameter. The gage consists of a base *A* of machine steel, on which are three holding blocks *B*, also of machine steel, and which house the gaging mechanism. The piece to be gaged is supported by the blocks *C*, of tool steel, hardened. The V-portion is ground to suit.

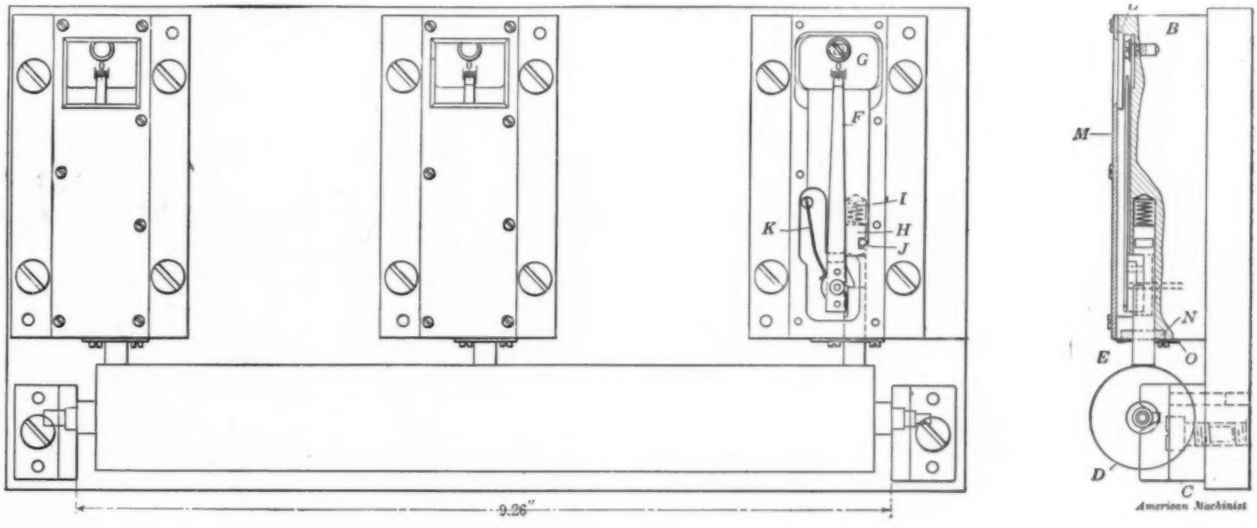
Operation of the Gage

The gage operates as follows: Any irregularity in the surface of the piece *D* will cause the gage pin *E* to bear against a small projection on the side of the indicating lever *F*, and the error will be magnified several times, and shown by the disagreement of the line on *F* and the graduated plate *G*.

The pin *E* is made to bear outward by means of the picce *H* and spring *I*. The amount of travel is limited by the pin *J*. A flat spring *K* is provided to keep the end of *F* in contact with *E*.

The graduated plate is covered by, and read through, the glass *L*, and the whole is covered tightly to exclude dust and dirt by the cover plate *M*. A leather packing ring surrounds *E* to exclude dirt, and is covered by a retaining plate *O*. A master gage is used for testing.

The above is a very excellent gage for cylinder work and could no doubt be used, with slight changes, for many varied purposes.



Gage for Testing Feed Rolls

Making Dies for Drop Forgings

By S. G. Hollander *

The selection of blocks, getting them ready to sink, laying out the impressions, sinking the impressions, hardening and drawing of drop forge dies.

*Superintendent, Union Manufacturing and Drop Forge Company, Providence, R. I.

The successful making of drop-forge dies is dependent to such an extent upon the experience and judgment of the person who determines how the piece shall be forged; that it is difficult to give much more than helpful hints in regard to drop-forge die sinking. However, there are certain fundamental principles that can be laid down, certain methods that can be outlined and certain dimensions that are more or less standardized that can be given, and these may be of considerable service to anyone interested in this line of work.

Selecting Steel for the Die Blocks

It is always advantageous to have a few pairs of die blocks constantly on hand in order that a rush job of die sinking may be started at once without waiting for a shipment of blocks from the maker. A good all-round grade of steel is a 60-point carbon open-hearth. This is very satisfactory for all kinds of forgings from low-carbon steel and copper, and from tool steel, provided the number of forgings required for a given set of dies is not too great. It can be properly called a good general purpose steel for die blocks.

If a large number of tool-steel forgings are required, it may be better to use tool-steel die blocks of 80 to 90 carbon. The shape of the piece, however, has something to do with the decision as to what kind of steel to use, and it must be remembered that high-carbon steels when used for die blocks are subject to the disadvantage of checking in use, because the temperature of the metal being forged tends to draw the surface and produce objectionable surface cracks.

If the work to be done is such that a large number of forgings are required, nickel steel, 3½ per cent. nickel, may be used for the dies.

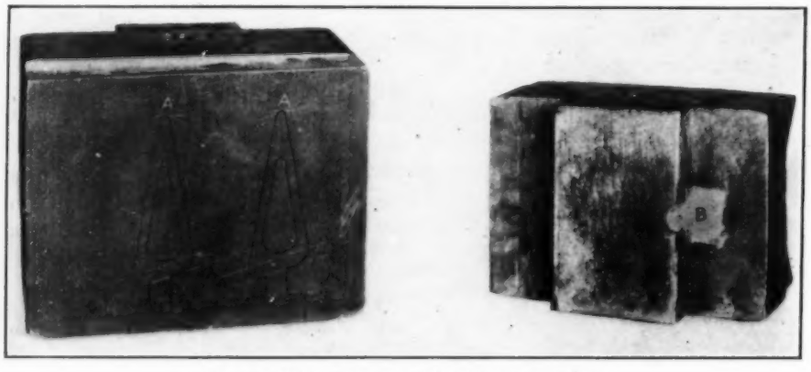


Fig. 1. A Drop-forge Die Ready to Sink

In former years cast iron was used for dies to some extent, but today, considering the low price of steel, there is no advantage in its use. It is not worth while.

Again, cast-steel dies are sometimes used for very large pieces having large and deep impressions that would take a great deal of time to work out from the solid. Many such dies give good satisfaction, the great trouble being in getting sound castings free from blow holes and other imperfections that, of course, cannot be tolerated if they happen to occur in the impression, or adjacent to the impression, so that it breaks down when the die is put into use.

To harden, it is best to pack in charcoal in a carbonizing box and heat. The method of dipping is very important as steam and air must not be allowed to pocket in any part of the impression and thereby produce soft spots. The usual method is to dip the die block face downward over a jet of brine pumped under pressure. This jet is allowed to strike directly into the impression, and by its motion tends to free the face of the die from all steam and air and produce uniform hardening.

After hardening, the die should be drawn in an oil bath at a temperature of from 500 to 550 degrees Fahrenheit. This treatment will give a die with a very hard surface, well backed up with a tough

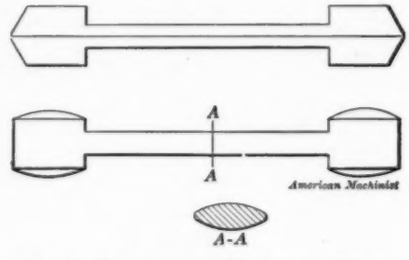


Fig. 2. Examples of Draft on Drop Forgings

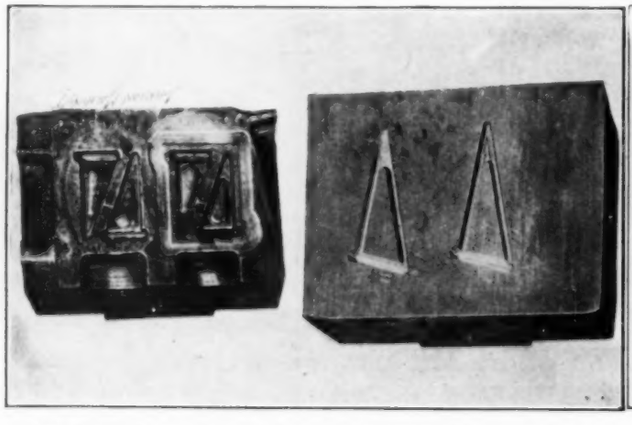


Fig. 3. Routing Out Dies and Double-forging Dies

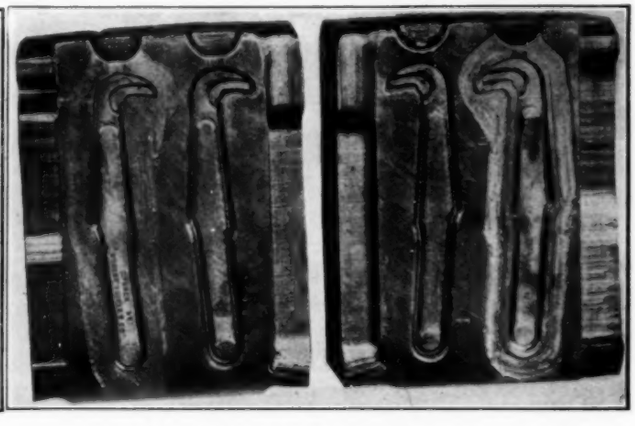


Fig. 5. Dies for Screw Wrench

softer back, and under ordinary usage a type of die that will not split readily in use.

Tool-steel dies are heated, dipped and drawn under the same conditions as the open-hearth dies.

Again, soft dies of 85 carbon steel, high in manganese, are sometimes used. The treatment is to heat these in a furnace in the usual way and then allow them to cool in the open air under an air blast. This type of die is of particular use in connection with large blocks that are liable to spring if hardened in any other manner.

Selecting the Size of Blocks

Judgment must be used in selecting the size of die blocks for a particular forging, in order that there may be a sufficient amount of metal around the impression to resist the tendency of the die to split in use. For ordinary work a safe dimension is 1½ inches on all sides of the impression. The thickness is, of course, directly dependent upon the depth of the impression, a general rule being to use a block 6 inches high, including the depth of shank, for all die blocks up to and including 8 inches wide. As the width increases increase the depth remembering that 8 inches in depth is seldom exceeded in ordinary drop-forge work. Taking the average run of small dies, we might tabulate the depth corresponding to various widths as follows: For 8 inches wide, 6 inches deep; 10 inches wide, 7 inches deep; 12 inches wide, 7 inches deep; 14 inches wide, 7 inches or 8 inches deep. At the same time it must be remembered that these dimensions cannot be followed as hard and fast rules, for the character of the impression is the determining factor.

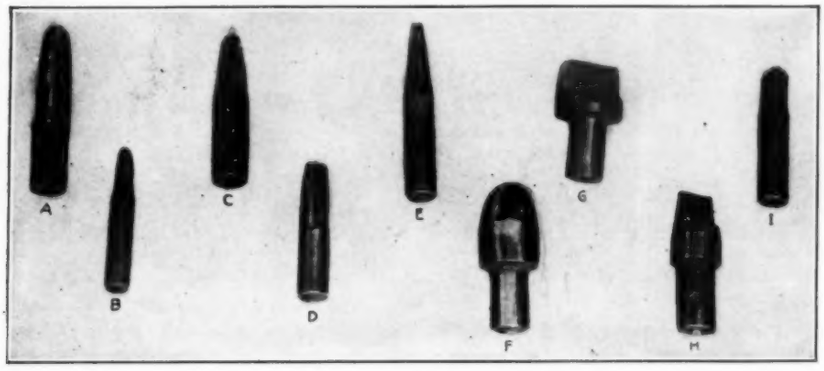


Fig. 4. Cutters Used in Die Sinking

Preparing the Die Block for Sinking

The first operation on a die block preparatory to getting it ready for sinking is to plane the face that is to receive the impression and one edge for a distance of about 1½ inches. See the block shown at the left in Fig. 1. These two cuts must, of course, be square, as all the subsequent work is laid out from them.

After these surfaces have been planed, the block is turned over on its face and the shank is planed, or perhaps milled. It is necessary to have different-sized shanks for different hammers. For hammers up to 1200 pounds a suitable size of shank is 4 inches wide, 1⅛ inches thick, with the sides dovetailed at an angle of 6 degrees with the vertical. The sides of the shank are parallel; the keying effect is obtained by means of a tapered key.

Similarly, for hammers larger than 1200 pounds and up to 3000 pounds good shank dimensions are 6 inches wide, 1½ inches deep, and the same angle of dovetail, 6 degrees. With the shank finished, the next operation is to plane 1½ inches of the surface of one end of the block square with the face and the strip already planed across one side, this end and the side forming the surfaces from which all the laying out is done.

The block is then milled on the bottom for the dowel pin, which locates the die in the shoe of the anvil block, or the ram as the case may be. This is merely a semi-circular milled cut that takes one-half of the dowel pin. Referring to the right-hand die block in Fig. 1, the chalked space shows the cut for the dowel pin and also the surface on the bottom of the block against which the dowel pin rests. This pin, by the way, is a square block with a cylindrical shank or pin turned on it, and securely set in the shoe of the anvil.

Laying Out the Impression

With the block ready for die sinking, the next operation is the laying out. Before this can be done the piece that is to be forged must be carefully studied. There are perhaps several ways in which a piece may be handled, and it is necessary to pick out the best one. It is necessary to have an idea of how the piece is to be machined or used, in order that draft may be placed where it will de no harm. As a general proposition, it is wise to put the draft on surfaces that are to be machined. In this way the draft is done away with and does not present any unsightly appearance on the finished piece. The essential things to watch out for are back draft, undercut and lack of sufficient backing up in the die.

To illustrate two ways in which draft may be handled, refer to Fig. 2, showing a lever having a boss on either end and a bar between of oval sections. The upper drawing shows this piece forged flat, with draft carried around the bosses. The lower figure shows this same part forged on the side, with the draft on the faces of the bosses, places that are to be machined. The second method is preferable.

On many pieces it is very easy to determine the parting, as the piece is symmetrical, or can be forged with one surface flat, or the like. Other pieces may be much more difficult. If this is so, it is wise to set the piece up on a surface plate and go around the entire outline with a square, and thus determine the proper place for the parting line.

Referring to the question of draft, 7 degrees is the minimum and more should be used if the nature of the piece will allow it.

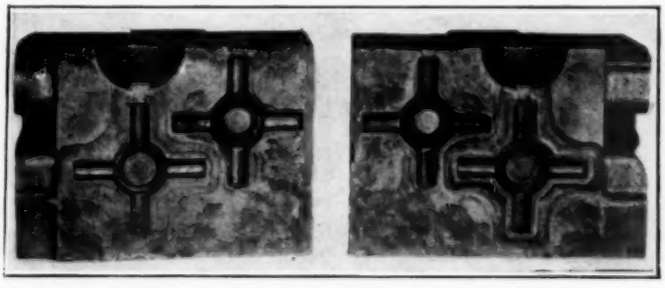


Fig. 6. Dies for Universal Joint Crosses

Fig. 7. Trimming Dies

When beginning to lay out the impression on the die block, first make a sheet-steel templet or several templets if the part is complicated. These templets can best be made from sheet steel 0.025 inch thick, although tin and zinc are frequently used. The major templet is of the shape of the forging at the parting line. Other templets are made of various sections of the forging if they are necessary. An illustration might be the bar of a lever that tapers between a large boss at one end and a small boss at the other. In this case it will be convenient to make two or three templets of the varying sections of the bar.

In laying out the parting templet and outline, care must be taken to add finish wherever finish is required by the piece, and this templet must also be laid out to allow for shrinkage. For general work it is sufficient to use a shrink scale of ⅛ inch to the foot, although this is slightly less than the real shrinkage of steel cooling from a forging heat to ordinary temperatures.

It must be remembered that everything is laid out from the top of the die. The surface of the block is coppered, the outline is scribed in the usual manner, then it is gone over very carefully with a tracing chisel in order to deepen the scribed lines, and give a line of sufficient width and depth, so that it can be split by a milling cutter in the die-sinking operations that are to follow. In addition to the outlines, it is customary to lay out the sprue and gate, parts of the impression that will be taken up later on in this article.

Referring to Fig. 1, the right-hand die block shows the laying out for two impressions.

Sinking the Impression

As all of the laying out is done on top of the die, it is necessary to sink the deepest impressions first. This is shown by the left-hand block of Fig. 3. Various styles of cutters are used for this work, several of which are illustrated in Fig. 4. Roughing cutters are of the kind shown at *A* and *C*. These are made with a taper of 7 degrees, the taper of minimum draft, usually have two flutes and cut on the end like a drill as well as on the side, the reason for this being that the cutter must be dropped directly into the block until the proper depth is reached, when it can be fed along to follow the outline of the impression. A finishing cutter is shown by *E*, and is similar to the roughing cutter, except that it has more flutes, often five. It is also made with a taper of 7 degrees.

A most useful cutter is what is known as the "hub cutter." Two of these are shown at *G* and *H*. In these cutters the flat is milled parallel with and up to 1/32 inch of a diameter, 1/16 of an inch measured on the circumference at the cutting edge is left of normal size, ⅛ inch is flattened off diametrically opposite and the back of the cutter is relieved considerably. This is a most useful tool in any die-sinking shop, and should be kept on hand in a variety of sizes.

Another useful cutter is the ball-end cutter, one of which is shown at *F* of Fig. 4.

In addition to these are gutter cutters and a large variety of special cutters made for particular jobs and to suit particular sections of the impression that is being sunk. A few such special cutters are shown by *B*, *D* and *I* of Fig. 4.

With these cutters the impression is worked out to shape and size as far as possible, and then the hand-finishing operations begin. These are carried on with hammer, chisel, scraper and riffle, finally producing the exact impression desired and leaving a very smooth-polished surface, so that there may be no roughness to hinder the flow of the steel during forging.

The number of impressions required to produce a given forging depends, of course, upon its size and shape, but for ordinary work it usually consists of a roughing impression and finishing impression, with an edger or side breakdown, the side breakdown being the first part of the die to shape the bar that is being forged.

For a great deal of work only the side breakdown and the finishing impression are required, and for still other more complicated work a series of dies with several impressions may be necessary.

The roughing impression is, as a rule, of the same shape and depth as the finishing impression.

The edger or side breakdown cannot be disposed of as easily. This is one of the most important parts of any die, for it is largely through the use of the edger that the stock is distributed into its proper location, in order that it will fill all parts of the roughing and finishing impressions. It is difficult to give any rule

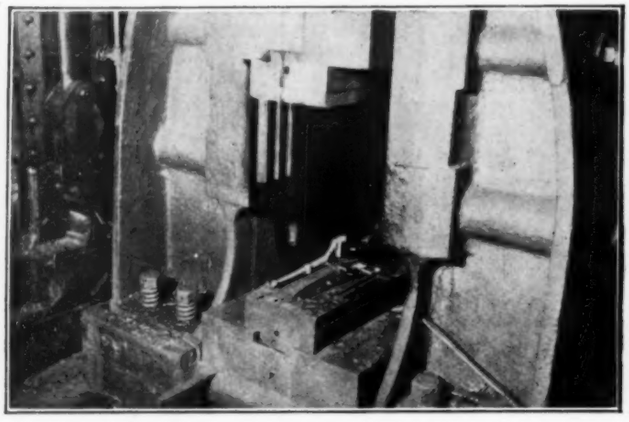


Fig. 8. Using the Edger

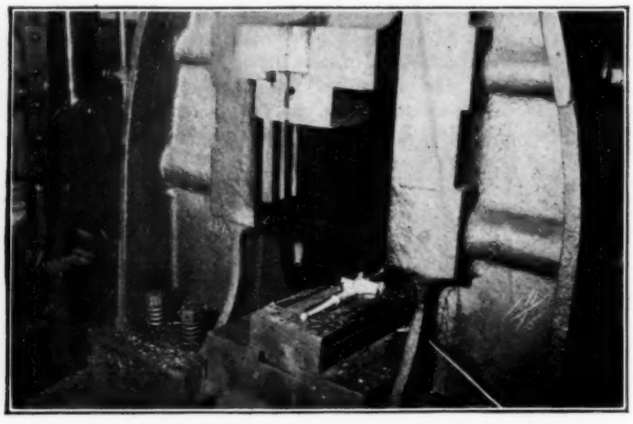


Fig. 9. Finishing the Forgings

Fig. 10. Specimen Drop Forgings

or suggestion for laying out this edger. One that is frequently quoted is that the parting templet should be laid on the side of the die blocks when they are together, the outline of this templet scribed, and then the edger worked out to within about 1/16 inch of the templet line. This rule is hardly of any value, however, for it is not important to approximate the shape of the piece in the edger, but to distribute the weight of stock so that the roughing and finishing impressions can shape it at the points wanted.

Another important part of some dies are the fullers or anvils. These are flat places milled near the edge or corners used to flatten out and draw the bar for thin sections of the forging, as for instance a part of lever between two end bosses.

The roughing or blocking impressions are used to preserve the correct shape and outline of the finishing die by using the latter only for a few blows when making each forging.

Turning to the illustrations, Figs. 5 and 6 show two sets of dies, each having an edger, a blocking impression and a finishing impression. The shape of the edger is of especial interest in Fig. 6, for by reference to the outline of the impression it is seen that it is necessary to spread out the stock into the rough shape of a cross before it is introduced into the blocking impression. Fig. 5 shows an anvil or fuller at the two inner edges of the die blocks, used to draw down the shank of the wrench.

Gutter, Flash, Sprue and Gate

On some lines of work it is advantageous to use multiple impressions, and thereby get two or more forgings at a time. This use of a multiple die is shown at the right in Fig. 3, where two wedge-shaped forgings are made at once. The flash of a forging is the thin part at the parting line, necessary as it is impossible to place just exactly the right amount of stock in a die to make a forging, and the edges of the impression are not allowed to come together and thereby suffer injury from a hammering action. Thus some stock squeezes out. The flash is trimmed away as it is useless. The parts of the die that form this flash can be seen in the extreme left-hand impression and extreme right-hand impression of Fig. 5. The groove around the impression that is to receive the flash is usually milled about ⅝ inch wide and 1/32 inch deep. In one of the blocks this groove is deepened about ⅛ of an inch except for a space of 3/16 inch close to the impression. This part is known as the gutter and takes the bulk of the surplus stock. From this description it will be seen that one side of the flash is flat, and that the other side is irregular, depending upon the amount of stock that flows into the gutter. The reason for the flat side of the flash is that such a side is necessary in order that it may lay down properly on the trimming die.

The sprue is formed by a small groove milled from the impression toward the outside of the die at the point where the bar stock is to be entered. It is merely the connecting piece between the forging and the bar. It is usually made as small as possible, the only requisite being that it shall be strong enough to sustain the weight of the hot forging during the process of forging, and hot trimming if the part is hot trimmed.

The gate is a recess milled at the edge of the block, large enough to take the end of the bar.

Selection of Stock

A word should be said about the selection of stock in regard to size from which a given forging is to be made. Conservative practice says, "make your die block first, and then test out to determine the best size of bar." However, many times it is impossible for a drop-forge shop to make such an experiment, as it is necessary to order the material before the dies are started in order that it may be forwarded and be ready to begin work at the earliest possible moment. In such a case it is necessary to determine the size of stock from a little figuring and much experience. As a general proposition, the stock should be no larger in size than is absolutely necessary. On the other hand, it is easier to draw the bar during the forging operation than it is to upset it, provided stock has to be provided for a deep, heavy part of the finished piece.

Figs. 8 and 9 show a part in the process of being forged. Fig. 8 with a part in the edger or side breakdown and Fig. 9 with the finished forging in the finishing impression ready for a final strike in order to straighten and perfect the shape after hot trimming.

Making Trimming Dies, Cold and Hot Trimming

There is nothing especially difficult or complicated in the making of trimming dies, either for hot or cold trimming. The steel for the die is usually 85 carbon tool steel of an inexpensive grade, hardened in water after machining and drawn to a dark straw. Care must be used in dipping in order to guard against distortion.

Such dies are usually made in halves, as shown by Fig. 7. They are registered by a dowel pin. The punches can well be made of low-carbon steel, say from 20 to 25 point carbon, provided they do not have to cut, but merely push the forging through the die. If any part of the punch has to cut, however, it should be made of tool steel and properly hardened.

The parting templet is used to lay out the outline on the trimming dies. This is usually roughed out a little small, and left for final finishing until after a forging has been produced. The surfaces of the trimming die are milled away to within about ¼ inch of the die opening, in order to leave only a small surface to grind in sharpening the dies from time to time. The inside angle of the die opening is 3 degrees and the outside of the block is usually planed to an angle of 5 degrees in order to hold it securely in the bolster of the trimming press. The punch is usually laid off from the die and its lower end must be shaped to fit the outline of the forging. See the examples of punches shown in Fig. 7. The standard punch shank is ⅞ inch wide across the flat, with a dovetail angle of 5 degrees.

Whether or not a piece is to be trimmed hot or cold depends very largely upon its size and nature. If the piece is very large, it is better to trim it hot. Again, if a piece is of slender section and rather delicate, it is better to hot trim so that the part can be restruck after trimming and thus correct the shape.

Cold trimming is used almost universally for small pieces.

Fig. 10 shows several specimen forgings, the two in the lower left-hand corner untrimmed; the rest trimmed. The large bracket in the center of this illustration is the one which is shown under the hammer in Figs. 8 and 9.

Diemakers' Slotting Tool

By P. De Vaux

Fig. 3 shows the tool, which can be ground to size and shape from ordinary self-hardening steel. It is used as shown in Fig. 2, on the work shown drilled in Fig. 1.

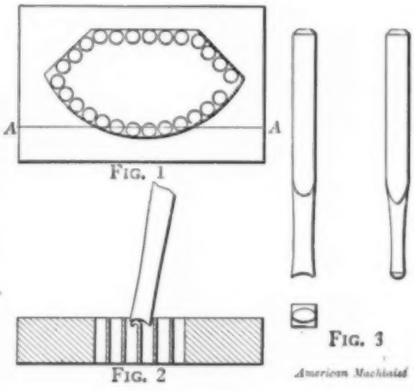


Fig. 1

Fig. 2

Fig. 3

American Machinist

Diemakers' Slotting Tool

The tool is much better and quicker than the usual cape chisel.

[Similar tools to these but rectangular in section are used in many shops for dies, cotter holes, etc.—Ed.]

Limits in Building the Sulzer Engine

By L. P. Alford

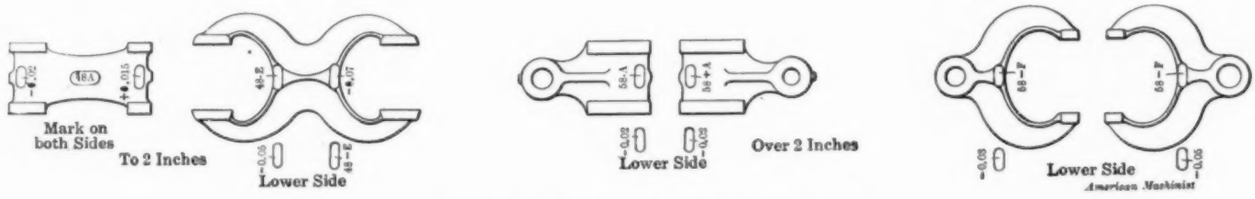
Six different kinds of limits used in building the well known European engine noted for accuracy of workmanship.

How the various limits are designated in a form both certain and simple.

One of the best known steam engines of Continental Europe is the Sulzer, built by Gerbruder Sulzer at their plants in Winterthur, Switzerland, and Ludwigshaven, Germany. These engines are noted for the accuracy of their workmanship and I feel particularly fortunate in being able to present herewith a table showing the limits as applied to different classes of work.

Four different kinds of limits are indicated, designated by letters and also by colors. The limit gages both for the standard holes and cylindrical fits are plainly stamped with these letters with nominal sizes and with the limits. The types of gages are shown by an engraving. In addition to those marks, each gage is painted with its proper color, so that a workman can tell at a glance just what gage is given to him by the tool room or what gage is lying before him on his work bench.

In English units, the tables cover sizes from about 7/16 inch to six inches. Two tables are given, the headings of which are identical, but the one has dimensions for both the nominal sizes and the limits expressed in millimeters and decimal parts thereof, a direct copy of the table furnished by Gebruder Sulzer; the other has three measurements transposed into English measurements.



STYLE AND MARKINGS OF SULZER GAGES

	±A Standard hole. Black.		−E Running fits. For general work. For rapidly revolving shafts. For shafts with several bearings. White.		−F Running fits. For more accurate work. For slow motion shafts. For fitted parts heated by steam. For overhanging pins. Red.		−M Close or pushing fits. Yellow.		±N Driving fits. Green.	
	Limits.		Limits.		Limits.		Limits.		Limits.	
Diameter in Inches	−A	+A	−E	−E	−F	−F	−M	−M	+N	−N
0.20 to 0.40	−0.0004	+0.0004	−0.0008	−0.0014	−0.0004	−0.001	−0.0002	−0.0004	+0.0004	−0.0002
0.48 to 0.72	−0.0006	+0.0004	−0.0012	−0.002	−0.0006	−0.0012	−0.00024	−0.0006	+0.00038	−0.00022
0.80 to 1.20	−0.0006	+0.0006	−0.0016	−0.0024	−0.0008	−0.0014	−0.00028	−0.0008	+0.00036	−0.00024
1.28 to 1.92	−0.0008	+0.0006	−0.002	−0.0028	−0.001	−0.0016	−0.00032	−0.001	+0.00034	−0.00026
2.00 to 3.00	−0.0008	+0.0008	−0.0024	−0.0032	−0.0012	−0.002	−0.00036	−0.0012	+0.0003	−0.0003
3.12 to 4.60	−0.001	+0.0008	−0.0028	−0.0038	−0.0014	−0.0024	−0.0004	−0.0014	+0.00024	−0.00036
4.80 to 6.00	−0.0012	+0.0010	−0.0034	−0.0044	−0.0017	−0.003	−0.00056	−0.0017	+0.00024	−0.0004

	±A Standard hole. Black.		−E Running fits. For general work. For rapidly revolving shafts. For shafts with several bearings. White.		−F Running fits. For more accurate work. For slow motion shafts. For fitted parts heated by steam. For overhanging pins. Red.		−M Close or pushing fits. Yellow.		±N Driving fits. Green.	
	Limits.		Limits.		Limits.		Limits.		Limits.	
Diameter in Millimeters.	−A	+A	−E	−E	−F	−F	−M	−M	+N	−N
5–6–8–10	−0.01	+0.01	−0.02	−0.035	−0.01	−0.025	−0.005	−0.01	+0.01	−0.005
12–14–15–16–18	−0.015	+0.01	−0.03	−0.05	−0.015	−0.03	−0.006	−0.015	+0.0095	−0.0055
20–22–25–28–30	−0.015	+0.015	−0.04	−0.06	−0.02	−0.035	−0.007	−0.02	+0.009	−0.006
32–35–38–40–42–45–48	−0.02	+0.015	−0.05	−0.07	−0.025	−0.04	−0.008	−0.025	+0.0085	−0.0065
50–52–55–58–60–62–65–68–70–72–75	−0.02	+0.02	−0.06	−0.08	−0.03	−0.05	−0.009	−0.03	+0.0075	−0.0075
78–80–82–85–88–90–92–95–98–100105110115	−0.025	+0.02	−0.07	−0.095	−0.035	−0.06	−0.01	−0.035	+0.006	−0.009
120–125–130–135–140–145–150	−0.03	+0.025	−0.085	−0.11	−0.042	−0.075	−0.014	−0.0425	+0.006	−0.01

Metals Inserted Into Die Castings

By H. C. Skinner *

A greater strength given certain parts of die castings or the wearing qualities increased, by casting into them pins, studs, bushings, rings, etc., that are made of steel, brass, bronze or other comparatively high fusing metals.

Methods employed to properly locate and anchor them in the castings so they will be perfectly tight and in alignment.

Considerable difference of opinion has existed of late regarding the adaptability of die castings to machine work in general. Some have attempted to employ die-cast parts in places that would even try the strength of steel; others, overcautious, have hesitated to use them at all, not knowing their possibilities. In reality, die castings are adaptable to a wide range of work, and while in general they should not be substituted for steel and like metals, many who are not now using them could do so to advantage.

In order to successfully design with a view to the use of die castings, certain points should be borne in mind. In general, Franklin metal, which is probably the best known die-casting alloy, compares favorably with cast iron. Many parts that are now made of brass could, so far as requirements in use are concerned, be made of cast iron, the only objection being the loss through machining. This loss is not experienced with die castings. In addition to this advantage over cast iron, the low fusing point of the metal aids in the extension of its general use, though limiting its value in certain directions.

*Manager of die-casting department of H. H. Franklin Manufacturing Company.

Parts Requiring Special Strength

It often occurs that a part requires strength or special wearing qualities at only one point in its surface. For instance, a projecting stud is subjected to special strain or a hole requires the bearing qualities of a high-grade, anti-friction metal. Because of the low fusing nature of the Franklin metals, brass, german silver or steel in the form of pins, shafts, rings, bushings, etc., may be successfully cast in to give added strength at such places. In the casting in of hardened steel, even the temper is not injured.

With a view of showing the possibilities in this line, the illustrations give a few of the many parts produced by the Franklin Company in which die castings are combined with stampings, screw-machine parts or the like. In each case it will be noted that the part would be ex-

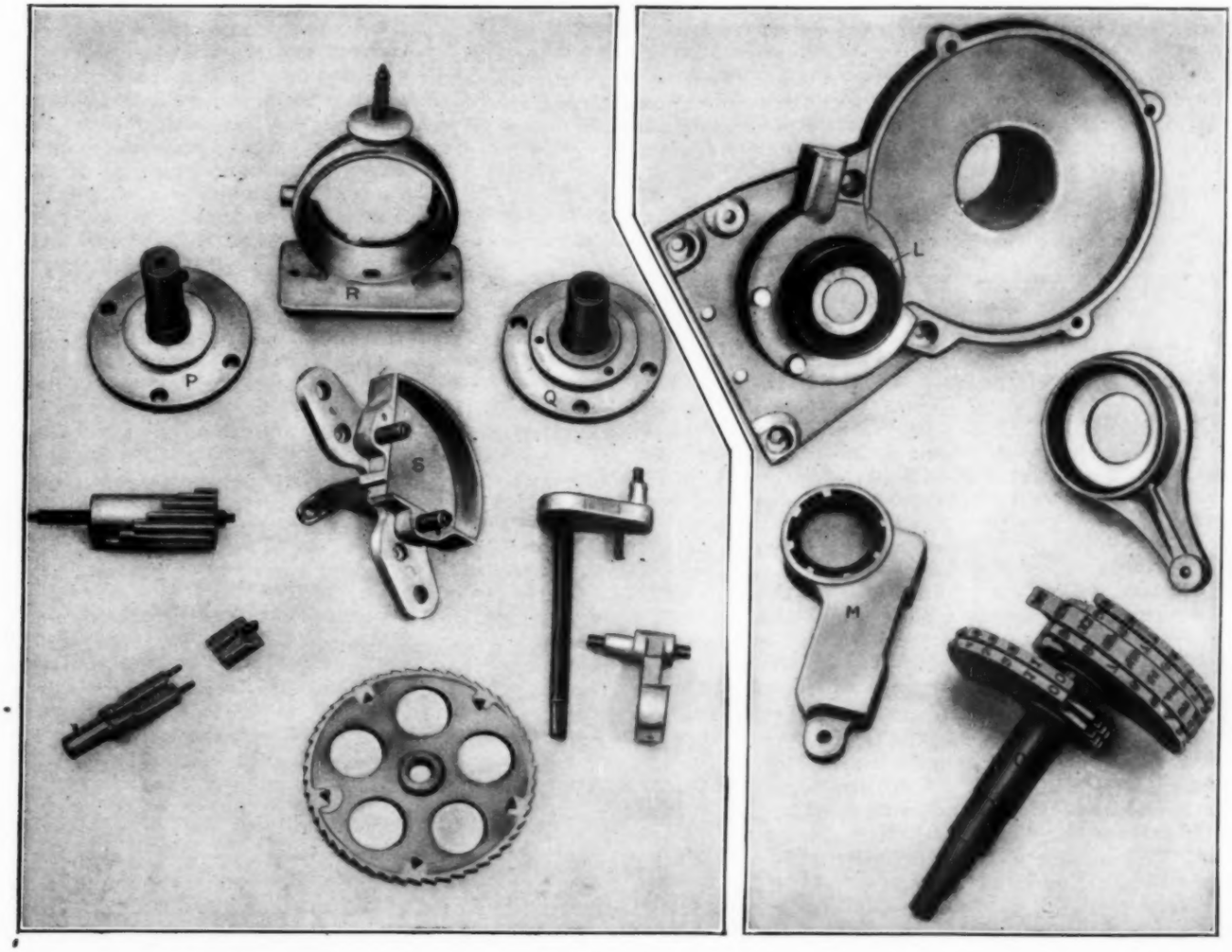


Fig. 1. Die Castings Strengthened By Having Pieces Shown in Fig. 2 Cast into Them

pensive if produced as a whole from the material of which the studs or rings are constructed. The cost of the die castings, however, is increased but little by their addition. The inserts as a rule represent stampings, screw-machine parts or sections of tubing, the cost of which is small.

Inserts and Where Cast

At *A*, Fig. 2, are shown two stamped steel cups or shells that are cast onto the hub of magneto casting *L*, Fig. 1. The steel surface thus secured, at the only place subjected to wear, is of great value while the added expense is slight. The cups are securely held in place by the three prongs slightly bent out, as shown at *A*.

Rings *B* and *C*, Fig. 2, show two types of brass rings that are used to meet the special requirements of the parts shown at *M* and *N*, Fig. 1. The manner of anchoring these can be clearly seen.

Part *D*, Fig. 2, shows a set of brass tubes, one fitting within the other. On these are cast type segments as shown at *O*, Fig. 1. Through the casting in of these, the economical production of these printing parts was made possible, the casting in of the tubes being much more satisfactory than the ordinary method of assembling similar parts, machine finished.

Studs E and *F*, Fig. 2, are cast into the armature end plates shown at *P* and *Q*, Fig. 1. These parts thereby meet rather severe requirements.

Part *G*, Fig. B, is an ordinary screws cast into piece *R*. Fig. 1.

Part *H* is a brass stud such as is used in the production of the movement bracket *S*. Fig. 1. The diagonal knurling shows a desirable way of anchoring the pins, as it prevents their pulling out or turning when the metal is once cast around them.

Bronze bushings *I*, *J* and *K*. Fig. 2, are used where special bearing qualities are required for some particular hole, and it is undesirable to make the entire part from either brass or babbitt on account of the increased cost. Small holes drilled into the sides of the bushing are the cheapest method of anchoring them. Other forms of pins that add strength at some required point are shown in the castings not mentioned.

Fig. 2. Steel and Bronze Pieces to be Cast into Die Castings

Preparing Inserts and Dies

These examples give only a faint idea of the possibilities of the reinforcing of die castings, but they may act as suggestions. Die castings are regarded as much more economical than either machine-finished brass or steel and should also be preferred because of their greater accuracy, where the same results can be secured. In making up the inserts, it is well to take into consideration some things that are of the utmost importance in securing the desired results but are not difficult to arrange for. The steel dies in which the pins or rings are inserted must of necessity be accurate in order to locate the inserted piece accurately in the casting. It is therefore essential that the pins or rings also be accurate.

Especially is this true of the inside diameter of bushings or rings that are slipped over a steel core in the process of casting. If the diameter is too great and the ring fits loosely on the core, the force of the metal entering the die will throw the ring to one side, thereby preventing the proper aligning of the hole. If, however, the diameter is too small, it is, of course, impossible to slip the ring on the core. The outside diameter of studs or shafts is of like importance and for similar reasons. The length over all is also a point which must be carefully considered.

A number of methods of anchoring the rings, pins, etc., are here shown. As the only object is to prevent their pulling out or revolving, any method which will overcome this danger is satisfactory. New forms of construction are constantly suggesting themselves, and the average designer can still further successfully extend the use of die castings if he will bear in mind the points just mentioned.

Double-end Toolmakers' Plug Gages

By F. C. Scribner

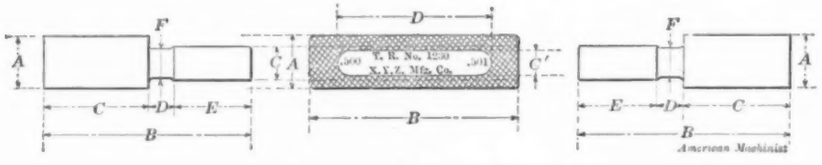
To concerns engaged in the manufacture of firearms, typewriters, adding machines and other product requiring close interchangeability, the expense of the tool department is a large item and anything tending to simplify the production of the jigs, fixtures and gages necessary to obtain this interchangeability is welcomed as a means of reducing labor costs.

In one prominent concern engaged in the manufacture of one of the above lines it was suggested that a set of double-end cylindrical plug gages, advancing by 0.001 inch, be placed in the charge of the tool-room attendant, to be given out on check to the workmen employed in the making of the various tools and fixtures. It was found that a large saving was made by their use.

These gages are made up by the insertion of two separate plug gages in a suitable handle upon which the sizes and tool-room marks are stamped, the handles being made on the screw machine and the plug gages being made on the bench lathe, using drill rod for this purpose.

The plug-gage ends are hardened, ground and lapped and are held in the handle by soft soldering, making their replacement, when worn, a matter of small expense.

In Fig. 1 is shown a sketch of the plug gage when assembled and the accompanying table gives a list of the sizes of the various parts, covering gages from 0.050 inch to 0.501 inch in diameter.



Toolmakers' Plug Gages

Sizes.	Handle. A	B	C	C_1	D	Plug Ends. A	B	C	D	E	F
0.050 to 0.175	$\frac{1}{4}$	$1\frac{1}{4}$	$\frac{3}{16}$	0.150	$1\frac{1}{4}$	Size of Gage	$1\frac{1}{4}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
0.176 to 0.245	$\frac{1}{4}$	$1\frac{1}{2}$	$\frac{3}{16}$	$\frac{1}{4}$	$1\frac{1}{2}$		$1\frac{1}{2}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
0.246 to 0.309	$\frac{1}{4}$	$1\frac{3}{4}$	$\frac{3}{16}$	$\frac{1}{4}$	$1\frac{3}{4}$		$1\frac{3}{4}$	1	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
0.310 to 0.431	$\frac{1}{4}$	2	$\frac{3}{16}$	$\frac{1}{4}$	$1\frac{3}{4}$		$1\frac{3}{4}$	1	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
0.432 to 0.501	$\frac{1}{4}$	$2\frac{1}{4}$	$\frac{3}{16}$	$\frac{1}{4}$	2		$2\frac{1}{16}$	1	$\frac{1}{16}$	$\frac{3}{8}$	$\frac{1}{16}$

Dimensions of Cylindrical Plug Gages from 0.050 inch to 0.501 inch.

Aim of the Worcester Trade School

By E. H. Fish *

An experiment to ascertain if industrial education will care for some part of the 95 per cent. to whom the public school system proves unattractive.

*Manager, Worcester School of Trades.

The fact that Professor Sweet and Mr. Stuart have brought my name into this educational controversy as well as the fact that I find that some rather queer misconceptions of our views have spread abroad in the land, leads me to try to put my position, and I think I may safely say, our position, at the Worcester Trade School before your readers.

The State of Massachusetts has a law by which cities or towns may establish trade schools, and encourages their establishment by offering to pay one-half the cost of maintenance. In order to get this State aid these cities must maintain their trade schools independently of the former public-school system. Worcester, having accepted this law and having established a school, is compelled to maintain it independently of the public schools.

From the fact that we are independent of the public schools many people have jumped to the conclusion that we are fighting the public schools. This opinion is entirely wrong. We have an entirely independent field and a practically unworked field and one fairly well defined by law. We very likely would fight to prevent invasion, but so far have had nothing worse than threats to contend with. Today, we believe that there is a very good understanding by both schools as to the boundary line between their fields.

We feel that Worcester has a very excellent system of public schools, well adapted to the needs of boys and girls who intend to fit for other and higher institutions of learning. We feel that this system of public schools does not do all that might be asked for the 95 per cent. or more who do not go further. This criticism is applicable to all other public-school systems so far as I know, and I believe is recognized by practically all educators. We are trying an experiment to find out if industrial education will care for some part of that 95 per cent. to whom the public-school system proves unattractive. That this 95 per cent. should be taken care of must be conceded, and no proof other than accessible statistics is needed to show that they are not taken care of by the public-school system.

We have no quarrel with higher institutions of learning. While we may question the value of a college education to many who have acquired it, we feel that our field is with boys who have never dreamed of a college education.

As yet, we are offering only three trades. This is entirely inadequate to the needs of a city with the diversity of interests of Worcester. Before we can approximately cover the field we shall have to offer twenty. Even with this limited choice the demand for admission has exceeded our expectations. We have had a few applicants whom we considered capable from a financial, mental and physical point of view, of profiting by a course at the Worcester Polytechnic Institute. These we have so advised. We have a considerable number of boys whom we believe capable of accomplishing much in the world, but we recognize that they could not pass the examinations for the Worcester Polytechnic Institute, nor if they were admitted could they stay there, which is no discredit to them any more than it is a discredit to a silk worm that he cannot weave a canvas tent. They were not born to travel that way.

We are not in any sense a fitting school for any other institution of learning. We believe that our boys will have just as good a chance of success in life as those who go to college or to technical schools, but we want to have a hand in writing the definition of the word success.

Because we do not fit boys for other schools we have been accused of being self-sufficient and narrow. Our course of study refutes this. From personal contact with a large number of technical graduates I feel safe in saying that we offer as much mathematics as *they* average to *use*. We lay our stress on the use of a limited range of mathematics and sacrifice the great number of rarely used problems. We offer the principles of physics that the average technical graduate uses. For thoroughness in these we sacrifice a large number of the more rarely used parts of the science. We recognize that our graduates will be seriously handicapped as compared with college graduates in research work, or original design, but that is not a fair basis of comparison. The only fair comparison would be between the boy that we graduate and the same boy if he had taken a college course. Inasmuch as the college would not admit many of our boys there is no basis of comparison except that of success as measured broadly, not in one line or another line, but taking into account all lines of useful service that a man may render to society.

We have been criticized for setting a low standard of admission and as acting as a settling basin for the dregs of the public school. To anyone who has seen the type of boy who has come to this school this seems like slander—either of the boy or the public school, for if these boys are dregs there must be something the matter with the strainer. I believe that these boys would have wasted their time in attempting to go further in the public schools, not because they are any less smart than those who have gone on, but because they and the public-school system did not fit. As a matter of fact 60 per cent. of them hold certificates entitling them to go further in the public schools. We believe that they would not have gone much further.

We have been accused of sneering at culture. This is farthest from the case. Of the pupil's time about one-sixth is devoted to subjects usually rated as cultural. To be sure we handle these subjects in such a way as to derive as great concrete good as possible, but on the other hand we treat our mathematical subjects in such a way as to get as great cultural value as possible consistent with their concrete nature. In fact the keynote to our difference from the old line system of education is to be found in our explicitly working from the concrete side of things. We do this through force of necessity. A boy of 14 or 15 can absorb concrete facts where the abstract is only reflected (judging by my experience at the Polytechnic Institute with older boys I should say that the same is also true there). Beginning with the concrete we can work toward the abstract as much or as little as the individual boy can be led. If we merely gave the boy practice we would not be an educational institution, by leading him to think about the practice we do become educational in our scope.

Our aim is to produce something more than a skilled workman. Do not misunderstand me. We are not aiming to produce foremen or superintendents. We wish to produce men who can understand the complexities of our modern social and political scheme, men who can read the news of the day with discretion, who can vote intelligently on matters of public importance, who will not be led away by cheap political talk, who can comprehend that cost of material and labor are not all the expenses of manufacturers. Taking the material as it comes to us, and deliberately taking material that has been or would soon be culled by the public-school system, as it stands today, we hope first to give it an earning capacity that will place it above the bread line and second to give it as great a capacity for intelligently enjoying itself among the accessible amenities of life as possible. Incidentally we hope to show that some of the amenities are not so far off as they have imagined.

Tools Used for Fire Engine Work

By F. A. Stanley

Construction and application of a drill-press device for chucking work of irregular outline requiring drilling and tapping operations. Castings held in this chuck are presented either side up to the tools, as desired, and the whole fixture easily set in any position necessary to locate the work under the spindle.

Some boring, facing and tapping tools for mounting directly upon the end of the spindle. Methods of inserting cutting blades and attaching the heads to the spindles.

A variety of useful shop tools and special appliances.

The Ahrens-Fox Fire Engine Company, Cincinnati, Ohio, uses in its shops an ingeniously designed chuck, or vise, for holding awkward, irregular-shaped pieces which have to be machined under the drill press. Two views of this chuck are presented in Figs. 1 and 2, in both of which it is shown gripping a curved "manifold" used in the construction of their fire-engine boiler. Several of the castings are shown at *A A* in connection with the chuck and it will be noticed that there are eight holes drilled and tapped taper in one side with their centers on the arc of a circle and a single taper hole tapped in the other side. This is only one of a variety of irregular pieces which the chuck is designed to handle efficiently.

Some Features of Construction

The chuck or vise proper *B*, at the top of the fixture, is mounted on trunnions in a stiff bracket which is dovetailed at the bottom to slide longitudinally on a guide formed on the top face of an intermediate slide which in turn is finished at the bottom to slide transversely upon a base plate secured to the drill-press table. The chuck thus has a swiveling movement upon its trunnions and may be slid easily upon the compound slides to right or left, and backward or forward. Two locking handles *C* are provided at diagonally opposite corners and the chuck may be secured as in Fig. 1 with the upper face in horizontal position, after which the locking handles may be swung outward and the chuck turned over on its trunnions and locked the other side up as in Fig. 2. In this way both sides of the work are presented in turn under the tool in the spindle.

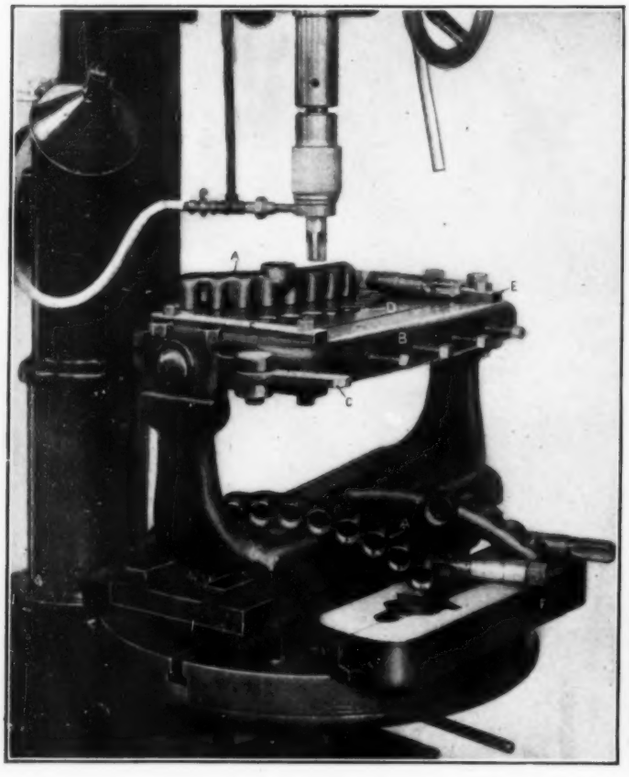
Character of the Jaws

The jaws *D* are shaped to conform to the outline of the work to be machined and are operated by the set screws tapped through the wall of the chuck. These jaws are all made with the same outside dimensions and the pair for any particular piece of work are readily dropped into place where they are retained between the two pairs of straps which are shown at *E* attached to the opposite faces of the chuck body. A few turns of the screws close the jaws or allow sufficient movement between them to permit the work to be removed and a new piece to be put in place.

A considerable number of special jaws have been made for use in this chuck, but only one pair, *F F*, are shown in the half tones, aside from those in place in the chuck. These views, however, give an excellent idea of the general form and proportions of the jaws.

Owing to the ease with which the fixture may be slid about upon its compound base, one hole after another in the work is very quickly brought into position under the spindle for reaming out and tapping. A homemade quick-acting chuck is used in the drill spindle for holding the tools and by simply lifting the nurled sleeve one tool may be instantly without stopping the spindle.

It is obvious that, where desirable, the work-holding chuck may be tilted to a position at right angles to that illustrated, removed and the other slipped into place or if deemed necessary, it could readily



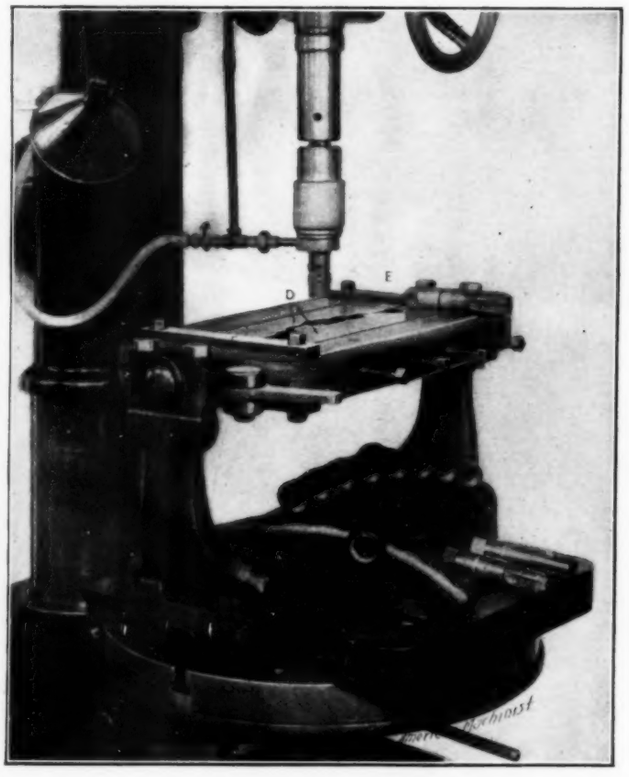


Fig. 1. A Convenient Fixture for Holding Drill-press Work Fig. 2.

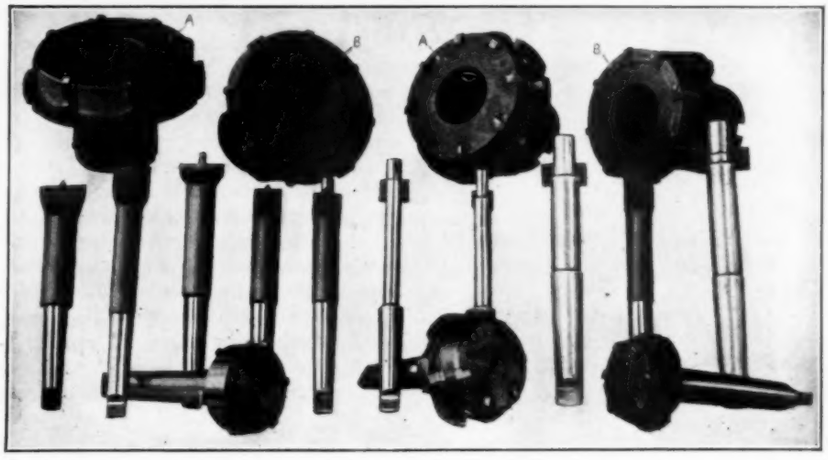


FIG. 3. A GROUP OF DRILL-PRESS TOOLS

be fitted up for setting at any desired angle throughout the circle.

INSERTED BLADE CUTTERS AND OTHER TOOLS

Several types of cutter-heads, taps and drilling and boring tools used extensively in the shop are illustrated in Fig. 3. The inserted-blade tools at the top consist of two boring and facing heads *A A* and two taps *B B*, all of which have extended hubs at the rear which are bored out and split so as to be clamped on the end of the radial drill spindle, the spindle end being reduced slightly to receive the tools. These boring and tapping heads are made in many sizes, but where too small to slip over the spindle are provided with taper shanks to fit into the spindle. Three such tools will be noticed in the foreground.

The inserted blades are secured in the heads by taper pins in the slots cut slightly in advance of the seats for the cutting blades. The cutters in heads *A A*, which also perform facing operations, are backed up by a plate attached by screws to the back of the head. It will be noticed that the rear end of the hubs are slotted crosswise to receive a driving key which passes through the drift slot in the machine spindle.

TOOLS FOR BOILER PLATE AND SIMILAR MATERIAL

Several taper shank tools are shown to the left in the foreground, as forged down at the ends and finished for drilling and boring boiler plate, cutting flue sheet holes, and operating on thin material of various kinds, etc. Three of these will be seen to have center cutting points while others are in the nature of counterbores which may, of course, be used in a variety of ways. The taper-shank bars with inserted blades are for boring, counterboring and facing where it is desirable to pilot the end of the tool.

AN AXLE RACK

The rack shown in Fig. 4 is made up of two A-shape frames securely tied at top and bottom and provided with strong pegs for holding fire-engine axles which are forged and finished in various shapes and sizes. A number of curved rear axles are shown in place at the front of the rack and several straight front axles at the rear. It will be noticed that the group includes both rough forgings and completely finished axles.

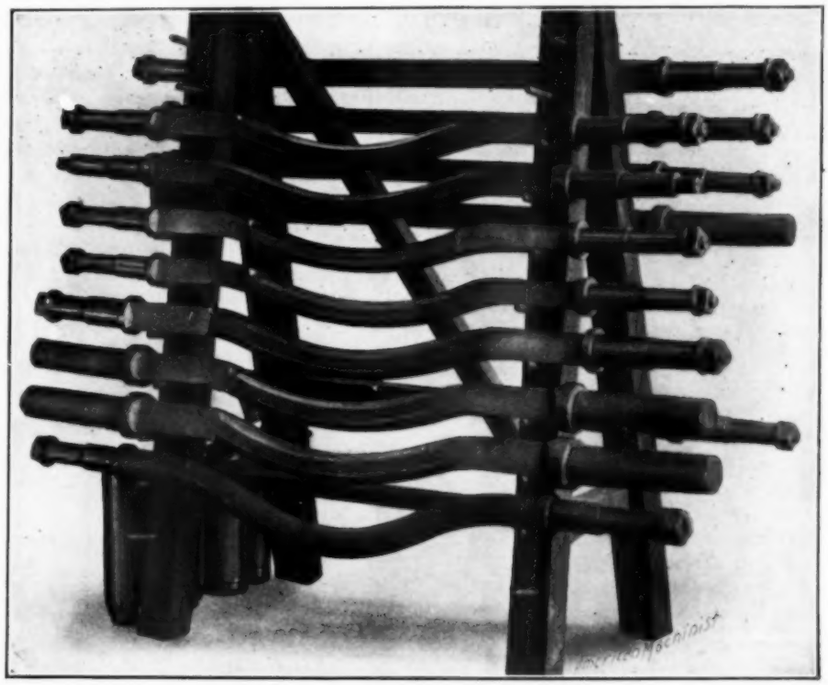


FIG. 4. AN AXLE RACK

Record of a Vanadium Steel Spring

We recently came across the use of a vanadium-steel spring that is of considerable interest.

The spring in question has a total length of 24 inches, is 1¼ inches wide and about ¼ inch thick, having three leaves, being bent to a semi-elliptical shape and having about 1½ inches camber. This spring is used on an automatic machine and is compressed and expanded from 160 to 200 times per minute, depending upon the operation of the machine.

These springs have been made of a good quality of carbon spring steel but with unsatisfactory and irregular results. Sometimes a spring would work for an hour, another might run for five hours and occasionally an exceptionally good one would run for about three weeks. This length of time was the maximum.

Some time ago the superintendent of the factory purchased 100 vanadium steel springs, to test against the ordinary springs they had been using. As a matter of fact most of the stock of 100 springs is still in the storeroom, as the new springs averaged two months of service each, against a maximum of three weeks with the other material.

It is reported that a noteworthy and probably epoch-marking ship of large dimensions has been ordered by the Hamburg-American line, to be built in Hamburg, in which, for the first time, certainly as far as the German marine is concerned, the steam boiler and external chimneys will be eliminated and internal engines substituted for steam engines. The vessel is to be 8000 tons and 881 feet in length. While the vessel is expected to be the largest in the world of this type when finished and will be constructed with every conceivable convenience for passengers and every known device to add to their security, it is not intended to establish a new speed record.

Modern Drawing Room Practice

By Alban Rice

Developments in the drawing room making for clearness and completeness. Experience with one-part drawings and part assemblies. The value of the use of limits of variation.

The requirements of drawing, used in uptodate machine manufacture, especially when the product is turned out in great quantities, are twofold; *clearness* and *completeness*. Efforts are steadily made to decrease all chances for errors in the shop due to misinterpretation or confusion in reading drawings, and also to increase given information.

In the smaller shop all the little odds and ends and minor details are left to the memory and experience of the foremen and others, and as long as the most important information is given, the manner in which it is given does not matter so much.

As the shop expands the demand grows both for means to avoid misunderstanding and mixups in reading drawings and for increased information. The necessity for development in these directions is apparent in the growing factory, where the different jobs frequently must change both foremen and hands for various causes. Another reason is obviously the fact that man's memory is limited, and it is both unsafe and unnecessary to rely on it for things that can better be taken care of by the drawings once and for all. Finally, when the orders increase in size and more is at stake, greater care must be taken to avoid confusion and errors.

One-part Drawings

One of the most important developments in modern drafting-room practice is the system of making "one-part" drawings, that is, each drawing showing only one part. These drawings are preferably of a small standard size; 5x8 inches or 10x8 inches, for convenience in handling.

Fig. 1 is supposed to be a part (in reality it is three parts) shown on a "multipart" drawing, together with a number of other details. This multipart drawing is provided with a catalog of parts giving the number, name, material, etc., of each part. It will be noticed that anyone ordering part No. 4 on this drawing must in his order mention for what particular machine they are wanted, thus: 100 of part No. 4 for 5 horsepower, drawing 60,-733. The foreman in the detail department must also take care that the workman does not get mixed up and make a few hundred of the wrong part. This method naturally causes both confusion and errors, and was superseded by the method shown in Fig. 2. The parts are still on a multipart drawing, but are given three different numbers, and can be referred to by simply using the individual part numbers together with the drawing number. Even this method, which naturally made the catalog of parts more complicated, was for same reasons unsatisfactory in the constantly growing shop, and the demand for three entirely separate drawings, as shown in Figs. 3, 4 and 5, seemed justified and to be the only way to avoid mistakes. A drawing showing only one detail is now handed to the workman. The foreman is certain of getting the proper parts made, and is relieved of unnecessary care. Only one number is now used in order. Each standard part becomes known by its number that never changes, and the stockkeeper's work in keeping track of his stock is greatly simplified.

This is, however, by no means the only advantages of one-part drawings. The small one-part drawings have the decided superiority over the large multipart drawings of ease in handling. They can be filed in a box, same as library cards (the larger ones doubled) in numerical order, which makes them readily accessible. The different departments in the shop receive only the drawings of parts they are interested in, whereas, as it often happens with the multipart drawings, they have to handle large sheets, where out of 20 or more parts shown, only one of two concern them. When a change is made of one part on the multipart drawings, new prints must be sent out, not only to the department interested in the change, but also to all others, who have to examine the new print only to find that the change made has no bearing on their department. Another advantage is the subject catalog that can readily be made up from prints. This catalog contains all parts that can possibly be used interchangeably, and is a ready reference in designing new apparatus. In this manner the duplication of parts, such as special nuts, screws, studs, spring washers, bushings, etc., is easily avoided.

As yet the practice of making one-part drawings is mostly confined to small and comparatively simple parts, that can be shown clearly on small sheets. Large and complicated parts must, of course, remain an larger sheets, which obviously cannot contain more than a few of them. Usually these parts are the castings that make up the framework of the machine and here, where the expense of making the drawings becomes a factor, it is still generally the practice, in cases, where two or more parts differ in some minor details only, to give the parts different numbers and specify the differences in a manner similar to what is shown in Fig. 2. This method, however, is not quite satisfactory for the reason that on parts with a great many dimensions, it is sometimes quite difficult to find the differences, unless they are prominently marked. A much better method, though slightly more expensive, is to show one part complete and simply outline the others (possibly in a smaller scale), specifying the differences only, and referring back to the original part for other details and dimensions. This method can be used to advantage in all cases, where parts, differing for example in machining only, are made from the same original casting, punching, molded parts, etc. On the other hand to show two or three complicated parts, that only differ in some minor respects, each complete in details and dimensions, is to add unnecessary work to everybody using the drawings, as it would take considerable time to pick out the differences which are, as often as not, necessary to know.

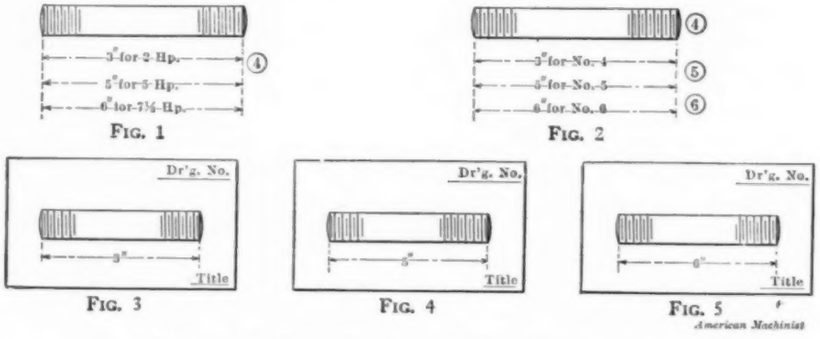


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

DIAGRAMS ILLUSTRATING DRAWING-ROOM PRACTICE

Part Assemblies

Another step toward greater clearness in drawings, and making an exceedingly useful guide and reference, both in the

shop and elsewhere, is the practice of making "part assemblies." These assemblies cover details that assemble directly together and form part of a machine, as for example the governor of an engine or the armature of a motor.

With the old method of one main assembly, now retained only as an outline drawing, it was practically impossible to show all the smaller parts, which generally are just the ones whose use and location would be questioned. Each part assembly, where even the most insignificant part can be clearly indicated, is shown on a drawing of a suitable size, together with a catalog giving the names and individual drawing numbers of all parts shown. This catalog also specifies the standard parts used, such as screws, washers, nuts, etc. Every detail called for in the catalog is given a part number (each catalog beginning with No. 1), and should be shown in the assembly with an arrow pointing to this number, in order to be readily located. Dimensions and notes referring to methods of assembling are also easily and well taken care of by the part assembly.

Limits of Variation

The most important development toward *completeness* in drawings is undoubtedly the practice of adding limits of allowable variations to dimensions. This practice is steadily increasing in range of usefulness and is absolutely necessary in order to get good results, especially when parts are made under conditions where the drawing is the only guide.

Again referring to the smaller shop, where the foreman is generally familiar with the intended use of the parts he is making, there is not so much necessity for this elaboration. If he is given a drawing of a part shown to be 3/16 inch in diameter, he will ascertain its function in the machine, and if, for example, a sliding fit is wanted for a 3/16-inch reamed hole, he will make it accordingly. When the shops grows and he has hundreds of different parts to make, he has no longer time to inform himself about their various uses, and he naturally demands more information from the drawings. At first such notes as, "sliding fit," "running fit," "driving fit," are added to the drawings, but this method is not satisfactory very long, as the opinion of what constitutes a certain fit naturally varies, besides, only a limited number of cases can be covered in this manner. The modern practice which seems to be entirely satisfactory is (continuing the above example) to give the diameter of the part in decimals with a limit of variation as, for example, 0.186 inch $\pm$ 0.001 inch, which obviously means that the diameter may vary 0.001 inch above and below the *nominal dimension*. This method of dimensioning enables the department foreman to make his parts without knowing anything about their use.

The understanding in regard to the use of common fractions, decimals and limits varies somewhat in different places and a certain interpretation should be agreed upon. Theoretically, 5/8 inch is the very same thing as 0.625 inch, but the accepted understanding makes quite a difference in the interpretation of the two ways of writing the same dimension. If the length of a certain part is given in common fractions of an inch, it indicates that the part will pass if, when measured with an ordinary scale, no appreciable variation from the desired length can be detected. Again, if the same dimension is given in decimals, it is the understanding that measurements with an ordinary scale are no longer satisfactory, and a micrometer measurement is wanted.

As yet most dimensions expressed in common fractions are given without limits of variations, that is, it is left to the factory to determine the *reasonable variations* in such cases. This reasonable variation naturally varies with the nature and size of the part, and no general rule can be applied. It is up to the designer to foresee and take care of such variations in his design. In cases where rough parts, such as castings, forgings, etc., vary more than what could be expected, or what is necessary, and where the reasonable variation is questionable, addition of limits should be made to the dimensions in question. Each such case must be judged on its own merits.

As previously stated, when micrometer measurement is necessary it is indicated by giving the dimension in decimals. There is also a strong opinion in favor of adding the limits of variations to *all* dimensions, thus expressed; the reason given is that a dimension specified in decimals without limits would indicate that an absolute accuracy is wanted. However, if the proper method of expressing allowable variations in dimensions is carried out, an absolute accuracy, if it could be obtained, would be expressed thus: 0.625 inch $\pm$ 000, and if this understanding is accepted, the decimal dimension without limits simply means that the reasonable variation must be judged by the micrometer instead of by the scale. If, based on the above reasoning, decimal dimensions without limits are allowed, the question arises: Where should limits be used? For a general rule it is safe to say that limits should be given in all cases, where variations greater than 0.005 inch above or below the nominal dimensions are unacceptable. Experience, however, better than general rules, teaches draftsmen just where the limits are necessary.

The proper method of expressing allowable variations in dimensions is to give to nominal dimension and specify the variation allowed above or below, or both, as the case may be; thus, 0.624 inch $^{+0.001''}_{-0.003''}$. If the limits above and below are the same, it may be written in this manner: 0.624 inch $\pm$ 0.002 inch. The practice of giving the maximum and minimum dimensions in full, thus: 0.621 inch minimum, 0.625 inch maximum, is not so satisfactory, as it leaves the shop in doubt as to which one of the dimensions is preferable. When accuracy is wanted on a dimension of even inches, it may be expressued thus: 2.000 inch with whatever limits considered necessary.

When a certain fit between two parts necessitates the applying of decimal dimensions with limits, care must be taken that the maximum allowance for the diameter of the inside part is not larger than the minimum diameter of the outside part, as there is always a possibility of getting inside parts with the maximum diameter and outside parts with the minimum diameter in the same delivery. At the same time, in case the parts should come in a reversed manner, there must not be excessive play or clearance.

It is obvious that in applying limits to dimensions, there is room for a good deal of judgment, based on experience, in determining allowable variations in parts. The designer or draftsman must be able to decide where the line should be drawn between the advantage of obtaining good work on one side, and the increased expense due to too close limits on the other side.

In many other minor ways is the information given on drawings increased. Material used is specified in detail, finishes such as nickelplating, japanning, lacquering, polishing, etc., are being added. The countersinking of holes is fully dimensioned. Notes like "slight C. S." or "Corner slightly rounded" are not acceptable any longer. Definite information and dimensions are wanted on everything. Methods of manufacture, in cases where procedure is complicated, or where parts are roughed out in one department and finished in another, are taken care of by drawings.

It is readily understood that the requirements for increased information from drawings on all the finer points and refinements, formerly left to the judgment of the shop, adds to the demand for an increased knowledge of shop methods on the part of the designing draftsman. He must also acquire an understanding of the comparative cost in the manufacture of different parts, in order to judge properly the range of variations than can be worked to commercially. Finally, it adds another point in favor of the argument that draftsmen must specialize, same as others in the technical profession, as it is impossible for one man to endeavor to learn and understand in detail more than one branch of apparatus successfully.

Convenient Card Sorting System

By Fordyce W. Brown

By cutting off the corners of the cards, according to their individual designation, it becomes an extremely easy matter to separate the different kinds by simple manipulation.

The machine which, by marked levers, shapes the cards in one cut to conform to the contour required.

Details of the card cutting machine involving simple design.

This article and acompanying drawings deal with a card system in use in the offices of a large general utilities company, in the meter department. In order to thoroughly understand the nature of the system and its requirements, we will begin by a description of the work done in that particular department.

There are two classes of meters to deal with; those for gas and those for electricity. Then, there are four different circumstances attendant upon each; viz., required to install a meter, either gas or electric, where there is none at present in position; required to change a meter from gas to electric, or *vice versa*, or take out an old one and replace with a new; remove a meter entirely, when building is not rented; change of tenant requiring new recording of meter.

These are the four different combinations which must be taken care of in the card system used. They are the same for either gas or electric meters, therefore one set of cards suffices for both. In the old system, the cards were alike in size and shape, the printed matter alone being different. In the course of a day's business these record cards accumulate rapidly, and formerly it required several hours to sort them into their respective piles, prior to filing. There are two carbon copies of the original, used in the different systems of filing, recording, etc., and, while not necessary to go into details, it may be said in passing, that the meter department usually figured that one day out of six was consumed in sorting record cards into their proper piles in order that the filing and billing clerks could work with them.

The System

In order to remedy this, the following card system was devised. The cards themselves are oblong, printed as shown in Fig. 1. A portion of each corner of the card, also a section in the middle at both top and bottom, and a small semi-circular portion at the right-hand edge, are reserved. These parts are bounded by black lines printed upon the cards, and no writing or notations must be made in them for the reason that from four to five of these sections are removed in the process of cutting each card into the shape designed for it, as will be explained later. All instructions, data, etc., are printed inside the black boundary lines on the card. Cards for electric and gas meters differ slightly in the printing upon them, of course, but the shape and size are alike for each.

The meter clerk has a number of these blank cards, and when it is required to record a "change" of meters, he puts into the card-cutting machine (which will be described later), a blank card for either gas or electricity, as the occasion requires, presses the "change" plunger on the machine and card issues cut in the form of Fig. 2. After filling in all notations on card and carbon copies, they are sent forth upon their various routes, which part of the system need not be entered into here. Likewise, when it is required to enter an order to "set" a meter, the same operation is performed except that the clerk presses the "set" plunger, and card is cut to shape as in Fig. 3. "Change of tenant," or "CT" cards, as they are known, are shown in Fig. 4, while the "remove" cards are shaped as in Fig. 5.

Ease of Sorting

It will now be seen that the cards differ from one another in contour, each card having all printed sections cut away except that one which bears the particular designation; that is, Fig. 2, which is the "change" card, has "Set," "Remove" and "C. T." portions cut away, thus leaving "Change" in place. Fig. 3, the "set" card, has all except "Set" cut away, etc. When all cards are assembled in one pile for distributing; i.e., for piling each in its own place, all "sets" together, all "C. T.'s" together, etc., the semi-circular notch on the right comes into play. If all cards are face up as they should be, the notches will coincide all the way down the pile. Should one or more be face down, the uncut left edge will be turned toward the right, thus blocking the notch, and showing immediately which card or cards are reversed, and enabling the distributing clerk immediately to remove and right them.

Supposing, now, that all cards have been piled, the reversed ones removed and placed face up. They are then ready to be separated, which operation is done in just three moves. First, taking the bunch with thumb and first finger of

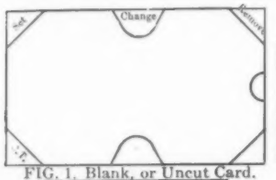


FIG. 1. Blank, or Uncut Card.

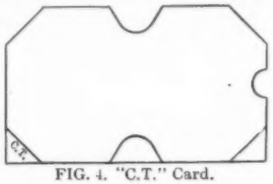


FIG. 4. "C.T." Card.

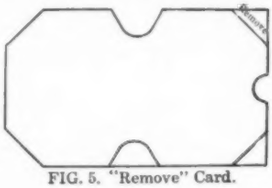


FIG. 5. "Remove" Card.

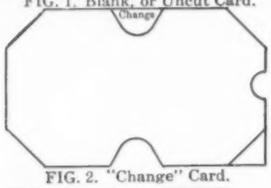


FIG. 2. "Change" Card.

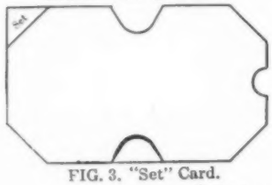


FIG. 3. "Set" Card.

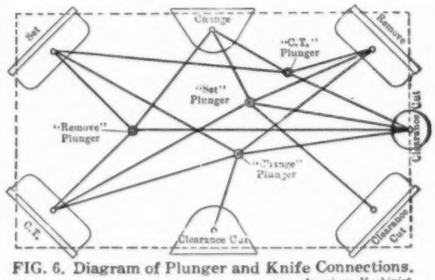


FIG. 6. Diagram of Plunger and Knife Connections.

Cards and Diagram of Cutting Machine

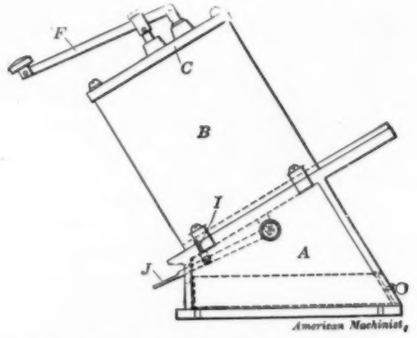


Fig. 7. General Outside View of Card-Cutting Machine

right hand at top, and thumb and first finger of left hand at bottom, fingers being placed in the sections bounded by black lines in the middle of the cards, the hands are drawn apart and all the "changes" will be in the right hand, since fingers of right hand will be holding that part of the "change" card which is not cut away. Fingers of the left hand will be holding parts of other cards and since the lower, middle section of each "change" card is cut away, there is nothing to interfere with free removal of "changes" from the pile.

Second move is to take cards similarly with left hand at upper left-hand corner, and right hand at lower right corner, and draw apart. Since the "set" cards have the upper, left-hand corner remaining intact with the card, and the lower, right corner cut off, while the two remaining kinds (the "remove" and "C. T.") each have a lower right and no upper left corner, it follows that this operation removes the "set" cards. The third operation sorts the "remove" and "C. T." cards, and is done by holding remaining cards with right hand at upper right-hand corner, and left at lower left corner, and drawing apart. Since "remove" cards have no lower left, and "C. T.'s" have no upper right, the operation of sorting will be plainly seen. The lower right corner is cut off only on the "set" cards; the lower middle section only on the "changes," the upper middle section on all but the "change" cards. The word "cards" is used in describing them, yet they are much thinner than those ordinarily used in a filing system, being printed on tough, white paper, in order to facilitate the carbon copying.

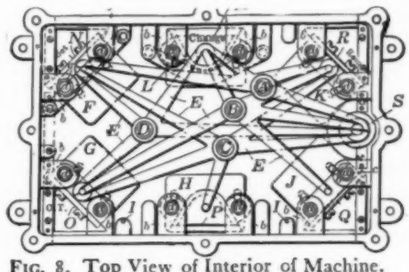


FIG. 8. Top View of Interior of Machine.

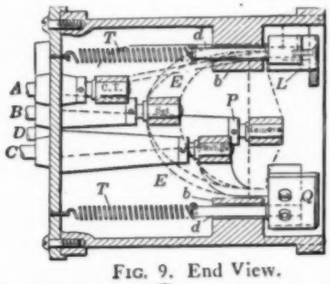


FIG. 9. End View.

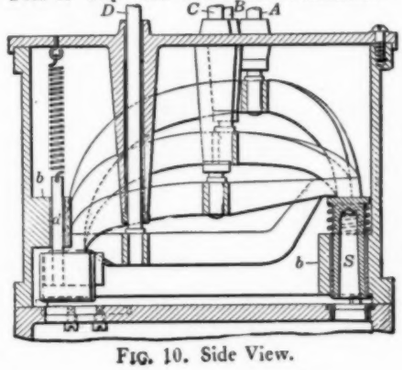


FIG. 10. Side View.

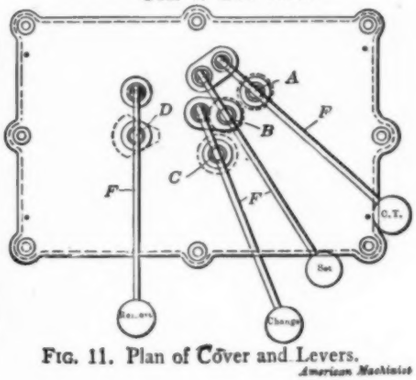


FIG. 11. Plan of Cover and Levers.

INSIDE VIEWS OF WORKING PARTS

THE CUTTING MACHINE

Having now described the system itself, we will notice the machine used for cutting the cards into the proper shape. Fig. 6 is an elementary diagram of the machine, and illustrates the principle in simplified form. There are seven knives, one for each corner, one for each middle section and one for the guide notch, the dotted line representing an uncut card in place. To cut a "change" card, the machine must cut off the "remove," "set" and "C. T." corners, also lower middle section and guide notch. By referring to Fig. 6 it will be seen that if the "change" plunger is depressed, the arms radiating therefrom to the above-mentioned knives will also be depressed and carry the knives down with them through the card below, thus cutting it to the required contour. By depressing any plunger of the machine it is possible to cut a blank card to the shape corresponding to that particular plunger.

Referring to Fig. 7, the essential parts of the machine are the base *A*, box *B* and the top *C*. Referring to Fig. 8, the box body has lugs *b b b b*, etc., to accommodate the knives *M, N, O, P, Q, R* and *S*. All the knives, except *S* (the guide notch), are provided with two steel rods *d d*, driven tightly into lugs. These rods extend vertically above the knives and slide freely in bushings in the lugs *b b b*. The knives are always kept at the uppermost limit of travel by means of the tension springs *T T*, Fig. 9. Construction of the knife *S* is shown in Fig. 10. It consists of a circular plunger working in a bushing and upheld by the compression spring above it. The plunger works in conjunction with the die below it to form an ordinary punch and die.

LEVER AND SPIDER ARRANGEMENTS

The top of the machine is shown in place in Fig. 11 and partial detail in Fig. 12, which also shows knife details. The plungers *A, B, C* and *D* correspond with those in Fig. 8, and with "C. T.," "set," "change" and "remove" cards respectively. These plungers extend through bosses which are bushed at each end, as in Fig. 10. The lower end of each plunger is driven tightly into the hub of its corresponding spider. These spiders are of cast steel, with arms so shaped as to engage with the requisite knives, and they lie in different planes, one above the other. The levers *F*, Fig. 11, have a 4 to 1 leverage, and at the end of each is a small knob marked with the name of the plunger to which it is connected. The details of connections are shown in Fig. 12. Plates *F, G, H, J, K* and *L*, Fig. 8, are the lower shearing blades and are held in place by screws from the under side of the base. They have a slight adjustment, forward or backward, the screws working in elongated slots in the base plate, as shown in Fig. 8. Suitable strippers are also included.

THE CARD STOP

Reference to Fig. 7 will show the mechanism of card stop, which consists of two pins *I*, which normally project a short distance above the edge of the base plate. When a card is inserted for cutting, it slides forward on the inclined plane until its forward edge strikes against these pins. After cutting, the lever *J* is pressed down, dropping the pins and releasing the card which slides out of the front of the machine.

Referring once more to Fig. 8, it will be seen that the location of all four plungers, *A, B, C* and *D*, is such as to equalize all strains put upon them when

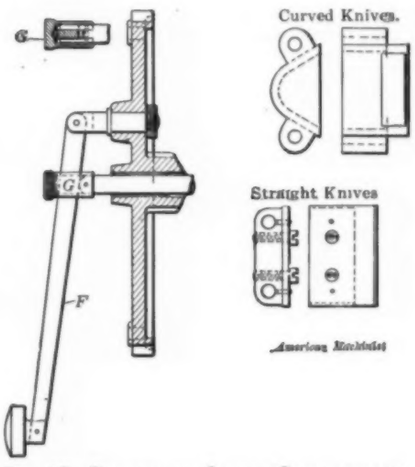


FIG. 12. DETAILS OF LEVER CONNECTIONS AND KNIVES

any one plunger, carrying all the knives connected with it, is presed down. The bosses are extended downward below the top plate to give support to the plungers.

The assembled machine is screwed firmly to a desk or table by screws extending through lugs at the foot of the base.

Several of these machines have been built and have been in operation about two and one-half years, answering well the purpose for which they were designed.

Turning Bevel Drive Gear Blanks

By J. O. Hub

The shape of the gear blank, amount of metal to machine off, jaws used to hold it and method of clamping it in the regular scroll chuck of a Gisholt turret lathe.

The tools used in the turret and the different operations they perform in machining the blank ready for the cutting of the teeth. The time consumed in machining them.

The machining of the main drive bevel gear, for the rear axle of an automobile, on a Gisholt turret lathe is an interesting operation. This gear comes in a drop forging that will machine to the size and shape shown in the upper view in Fig. 1. They have from 1/16 to 3/16 inch of stock to be removed on a side, or from 1/4 to 3/8 inch over all. They have the radius at *A* forged and are gripped at *B* with a special set of jaws that fit in the regular scroll chuck which is a part of the regular equipment of the lathe.

Chucking the Forging

In the lower part of Fig. 1 these jaws are shown removed from the lathe. A careful examination will show a small pin in the outside face of each jaw. These are used to true the blanks up sideways; the pins all being the same hight. A further examination will show two small notches in the gripping part of the jaw, which is the knife-shaped edge *C C*. These jaws made it possible to bore, face back, turn the outside diameter and turn both front and back angles all at one setting. This left nothing but the "cupping out" for the second and final operation.

The rough forging was put in the jaws and held firmly against the pins by placing a piece of 2-inch square steel across the back of the forging and then bringing up against it one of the supporting ar-

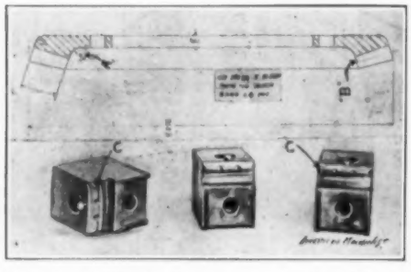


Fig. 1. Gear Blank and Chuck Jaws

bors in the facing head on the turret. Afterward the turret carriage is locked in this position with the clamping lever *D*, Fig. 2. This held the forging up against the pin while the jaws are forced out and into it at *B*, Fig. 1.

In this way the small teeth in the jaw became imbedded in the forging and not only did the driving but prevented the blank from coming out. In the last lot of 200 forgings only two had slipped in the jaws.

The Lathe Work

In Fig. 2 is shown the lathe, set up for the first operation, with a finished forging in the chuck. After putting the forging in the chuck it was roughed off on the back face with a roughing tool in the tool post; its carriage being up against a fixed stop. While this operation was going on the blank was bored with the roughing cutter and boring bar *E*. The facing head was then brought into use, and with the pilot bar *F* supported in the bushing in the chuck, cutter *G* faced the back, *H* turned the diameter, and *I* put on the back angle. Next the face angle was roughed with the tool *J*, also against a stop. Afterward the finishing head with its cutters was brought into play, the face angle finished with tool *K*, and lastly the hole finish bored with the finishing bar and cutter *L*.

The first operation averaged thirteen minutes each in lots of 250; with an inexperienced man, who had been broken in, running the lathe. While I was looking on, a blank was put in and the first operation completed in ten minutes. For the second operation, which was finishing the inside, they were caught in a special set of jaws that were turned out to fit the angle of the gears. This operation took six minutes, making nineteen minutes to bring the piece from the rough forging to the finished blank, ready for cutting the teeth.

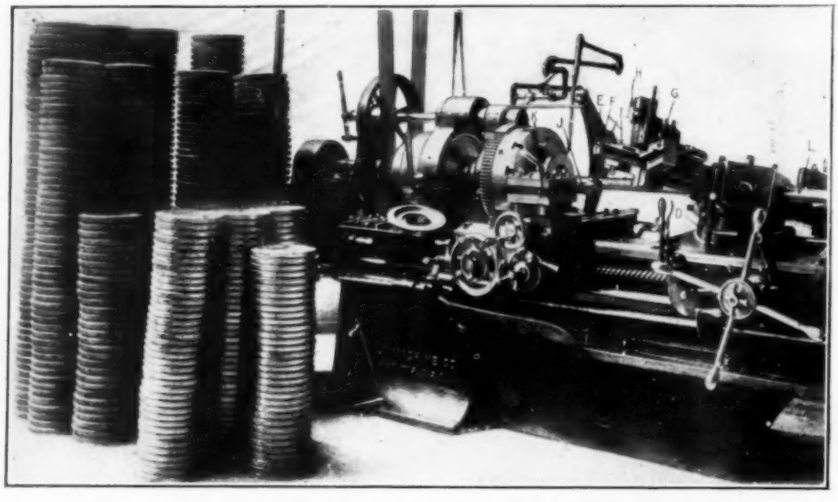


Fig. 2. Turret Lathe Ready to Machine Bevel-gear Blanks

In illustrating a point in his discourse a well known theologian recently revived a story of a young lady who told how a locomotive was made, after a visit to the Baldwin Locomotive works.

"You pour," she said, "a lot of sand into a lot of boxes, and you throw old stovelids and things into a furnace, and then you empty the molten stream into a hole in the sand, and everybody yells and swears. Then you pour it out and let it cool and pound it, and then you put it in a thing that bores holes in it. Then you screw it together, and paint it, and put steam in it, and it goes splendidly, and they take it to a drafting room and make a blueprint of it.

"But one thing I forgot—they have to make a boiler. One man gets inside and one gets outside, and they pound frightfully; and then they tie it to the other thing, and you ought to see it go!'"

Cost System for Shops of Medium Size

By Strickland L. Kneass *

Cost systems for shops of intermediate size, comprising sufficiently complete records, with comparatively little clerical labor, are difficult to devise.

A system in use by a manufacturer of brass injectors, the work being the production of large lots of duplicate parts. Accurate costs, checking of weights and individual workman's record clearly shown.

In the small, so called "one-man shop," the cost system must necessarily be extremely simple in order that it may be inexpensive. This usually results in all of the cost-keeping work being done by one man, who not only has many other duties to perform, but is often obliged to carry most of the "system" in his head. In the large shops we have all seen examples of complicated, and complete, though probably expensive systems. The transition stage, that is, the intermediate sized shop, larger than the one-man shop and smaller than the extensive manufacturing establishment, is the most difficult one for which to devise a satisfactory, and at the same time inexpensive, system of cost keeping. An example of such a system is that in use in the injector department of the plant of Wm. Sellers & Co., Inc., of Philadelphia, Penn., where duplicate, brass injector parts are manufactured in large lots for stock.

The accompanying illustrations show the cards and sheets used for this system, and it will be noted that the objects attained are an accurate determination of the cost of each lot of parts going through the shop, and an accurate check upon the weight of all lots of parts in each department, thus preventing the disappearance of material so often prevalent in brass-manufacturing establishments. Furthermore, the system is very simple, requiring but a small amount of clerical labor.

*Manager, injector department of William Sellers & Co., Inc., Philadelphia, Penn.

Foundry Order-slip. Weight Check

Referring to the illustrations, Fig. 1 is an order slip, which is printed in black ink, and which is bound in a pad with attached sheets, shown in Fig. 2, which latter are printed in red ink. A carbon sheet placed between the two, transmits the writing from Fig. 1 to Fig. 2. Thus, when an order is entered with the shop, Fig. 1 is filled out and sent to the foundry, which then proceeds to make the castings. At the same time, Fig. 2 is sent to the machine shop as a memorandum to let them know that the castings have been ordered from the foundry.

When castings are finished, the black order slip is sent to the machine shop, marked "O. K.," but without stating quantity or weight. The position of this slip in the machine-shop pigeon hole indicates that castings are ready for delivery. If the pigeon holes contain red slips and no black slips, the foreman is aware that the proper castings are ordered and

1-45 P
2M-1-10

OK 11/1

ORDER SLIP.

20 October 191 0

1021 **Deliver to Injector Department**

~~1000~~ pcs. No. 375 for No. 10 Injector class F

special pattern

Charge Injector account Weight 973 lbs.

Wanted 7 Nov. Delivered 4 Nov-

Signed FR

American Machinist

Fig. 1. Black Order to Foundry

MEMORANDUM.

20 October 191 0

1021 **Ordered from Brass Foundry**

~~1000~~ pcs. No. 375 for No. 10 Injector class F

special pattern

Charge Injector account Weight 975 lbs.

Wanted 7 Nov Received 4 Nov-

Signed FR

American Machinist

Fig. 2. Red Memorandum Sent to Machine Shop

PIECE WORK TICKET

#10 Injector Class F Pc. 375

Restarting Pat. ○ Special

CUT TICKET NO.	STARTED FINISHED	WORKMAN'S NAME QUANTITY	ACCEPTED PRICE, EACH	WAGES PAID	
1	11/5	Smith	Ⓡ		
7521	11/8	1020	1.1¢	11	22
2	11/5	Jones	Ⓡ		
7522	11/9	1016	0.4	4	06
3	11/10	Brown	Ⓡ		
7523	11/14	1016	1.5	15	24
4	11/13	Harvey	Ⓡ		
7524	11/18	1015	2 2	20	30
5	11/22	White	J.P.		
7525	11/23	1012	0.2	2	02
6					
7					
8					
9					
10					
	DATE 11/4/10	QUANTITY 1021	WEIGHT 971		

American Machinist

Fig. 3. Piece-work Ticket

being cast, but not completed; this method, therefore, shows the foreman the real state of all orders.

When castings are finished, the black ready to machine the castings, he returns the black slip to the foundry and the castings are weighed in the foundry storeroom, the weight being entered upon the black slip. The castings are then dropped down a chute to the machine shop, independently counted, and weighed on the machine-shop floor, and this weight and quantity entered upon the red slip, thus getting independent weights and quantities which must, of course, agree. The foundry is then credited and the machine shop charged with this material. The red memorandum never appears in the foundry on account of the necessity of independent weights.

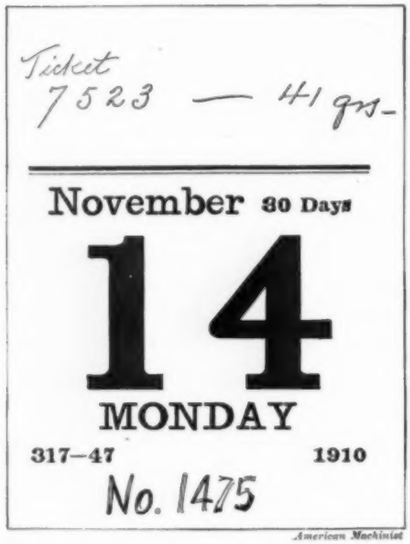


FIG. 4. PAD-CALENDAR SLIP FOR OPERATOR'S DAILY RECORD

The total weekly weights as returned by the machine shop on the red slips, are totaled in the office and must agree with the summation of the black slips as returned by the foundry.

PIECE-WORK TICKET

With the weight and quantity noted on the red slip, the foreman sends it to the piece-work clerk, who is thus advised that the castings are on the floor, ready for machining. The latter then makes out the piece-work ticket, Fig. 3, one of which is used for each lot of parts. In the first column is a number which is given to any one particular cut, these numbers being consecutive and referring to that cut only, for that particular lot passing through the shop. This number is not used again for any other job or lot. At the bottom of Fig. 3 will be seen blanks for date, quantity received, and total weight; these being filled out first by the time clerk, from the machine-shop red slip. The cut ticket numbers, and piece-work prices are also filled out by the time clerk, copying from standard tables which show what operations will be required on each particular part.

As the pieces are being finished in the shop and transferred from one machine to another, they are counted to check the quantity finished during each cut by the workman, so as to check the number of parts for which payment is to be made. This quantity is entered by the foreman on the ticket in the space to the left of the piece-work price, which facilitates the extension to the right-hand

No. 1475 William Brown Lathe Week ending
Brass Shop Nov. 12th

10,000-4-'10 P

CHARGE		Errors and defects	Time on unfinished work (to be deducted from total)	SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.	Total Time / Unfinished Time	D. W. Time	P. W. Time	Contract Price	Amount Due
No. of Ticket	No. of Order														
Allowance															
Day Work															

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FIG. 5. PORTION OF PAY-ROLL SHEET

1-91 5000-1-10-L.

10 Injector
Class F Valve

STORES ACCOUNT
INJECTOR DEPARTMENT

Pc. No. 375
Special

DATE	QUAN. DEL.	STOCK	DATE	QUAN. DEL.	STOCK	DATE	QUAN. DEL.	STOCK	DATE	QUAN. DEL.	STOCK
		121	12/1		938	12/15		798	← Order for		
11/23	1012		2	110					Stock		
			3	5							
	1133		5	45							
			6	30							
11/23	25		7	220							
24	50		8	5							
26	5		9	1							
28	10		10	60							
30	105		12	150							
	195		14	10							
				636							

Library Bureau G73050
American Machinist

FIG. 6. REVERSE SIDE OF PIECE-WORK TICKET, SHOWING STORES ACCOUNT

lot of parts through the different operations, so that when all the operations are finished, there is a total labor cost for the actual number of parts finally completed in perfect condition and also an exact record of the percentage of spoiled pieces. These cards are filed away, and from time to time the costs of the various parts composing the injectors are compared, to see how prices stand. The prices per piece are seldom changed, this being done only when simpler and more expeditious methods can be adopted; in such cases a percentage of time is credited to the man, so that with the labor-saving device he can earn higher per hour rate than before the lowering of the piece-work price.

column, where the wage earned by each workman for each cut is entered by the pay clerk. The work and ticket are then transferred to the next workman and the same system repeated; if any parts are defective or spoiled, it is indicated at once by the reduced number of total parts shown during the several operations. A comparison of the final number of completed parts with the original total number of castings marked at the bottom of the ticket, shows how many parts were spoiled, or defective.

On the piece-work ticket the foreman enters the name of the operator; as, Brown, cut No. 2, ticket No. 2573. The total labor cost for each cut, for the lot, is entered at the right, under "wages paid." One ticket, Fig. 3, follows each

THE WORKMAN'S DAILY RECORD

Each workman in the shop is supplied with a pad calendar, such as is shown in Fig. 4. Upon this calendar slip is entered the operator's pay number; as, for Brown: 1475, and his ticket number with time spent: "Ticket No. 2573, 41 quarters;" time being measured in quarter hours, there being 41 quarter hours per day. These slips are sent to the time clerk at the end of the day, and from these the payroll is made out.

Fig. 5 shows the payroll sheet for any one particular man, showing the total number of quarter hours each day spent upon each operation, and it is at this

point that any abnormal amount of time spent upon any particular set of parts may be discovered.

Frictionless Friction Drives*

By Charles E. Duryea

The type of friction drive referred to consists of the grooved rollers with angular grooves such as are used for driving fire pumps and similar machinery. In a light automobile carrying two passengers, it was only necessary to hold the wheels together with a 10-pound pressure on a 8 to 1 lever, making 80 pounds at the contact points, on level roads. On a 13 per cent. grade, 25 pounds pressure was required, and in a soft-surface upgrade 50 pounds were occasionally necessary. The majority of roads required under 20 pounds.

A groove of 40 degrees was finally adopted as being reasonably free from friction and yet having good pulling power. To secure ample surface for long wear, several small grooves are found better than a single large one. A further advantage is that the short surface angles have less friction loss by the slight twisting action of the surface on each other. Thus, the friction surfaces are about 3/16 inch wide, six or eight in number, giving a friction surface of 2 inches to 2½ inches wide, with no part more than 3/32 inch from the central line of neutral slip. The amount of friction surface can be increased at will by adding more grooves without increasing the loss. Thus, the life of the device can be made as long as seems advisable, with no loss except added weight, and the necessity of telescoping the shaft ends further in changing the ratios. If the twisting loss is made less by the use of narrower surfaces, there is more danger of the roller running in the next groove instead of its proper position.

Numerous experiments indicate a friction coëfficient of 0.65, as compared with a coëfficient of 0.11 of flat steel wheels on steel rails at 10 miles per hour. This gain in driving facility has been accomplished by grooving the rollers and rings.

The coëfficient of straw fiber and aluminum as commonly used is 0.18 to 0.27, which is considered as the maximum high-gear condition and not the average. The average of three tests showed an efficiency of 91.2 per cent., a loss of less than 9 per cent.

The life of this device, as applied to automobiles has not yet been established, as they have been in use but four years. Cast-iron rings having four ridges, or eight surfaces, were tried and wore out in 500 miles of severe work, with much slipping and starting and nursing the engine to avoid using low gear. Rings of soft steel will sometimes start cutting and tear themselves to pieces in a thousand miles. Generally they can be saved by a slight application of grease or graphite, but they chatter more frequently and have no advantage except that the rollers take hold with less pressure.

The rollers which have given best results are made of stock 3/16 inch thick and set with 1/16-inch clearance. The small roller is one piece, but the large rollers are built up in disks and have spacers to avoid the difficulty of cutting the narrow grooves. They are of soft steel and hardened. The rings consist of a main body of T-iron, electrically welded to length, carefully trued to a circle and turned on their inner surface, in which three or four slight grooves are cut to receive the wearing rings. These are rolled edgewise to a trued circle and simply snapped into these grooves by springing the ends sidewise and butting them together, followed by forcing them back into their plane. They are easily renewed when necessary. The reverse-driven ring is usually made of one solid piece, turned to shape with no provision for renewal, because the amount of use it receives will not wear it appreciably.

The use of grooved friction gearing is old, and probably goes back to or beyond the use of pin and lantern gears. It is used in foundries for turning tumbling barrels and similar service where tooth gearing would not last one-quarter as long. In well-drilling hoists and similar places, where there is more or less constant exposure to mud and grit, it gives good service. It seems to be the one drive which does not suffer from such exposure. Grit helps the surfaces to take hold of each other, and they drive without reference to mud of any consistency or material.

Although used for so many years in some classes of work, it seems to be almost unknown in others, and it is quite probable that there are additional places where it might be used to advantage.

*Extract of paper before Society of Automobile Engineers.

Where Chatter Was Not Due to Gears

By John R. Godfrey

It is the easiest thing in the world to fool yourself into believing something that is not so and to believing it so hard that you are ready to build a theory based on the results of the case.

When any work in a lathe chatters we look wise and say "gears" in a way that betokens knowledge beyond the common lot. And we are usually right—but not because it is a case of gears so much as because they are not *good* gears.

A well known grinding-machine man built a grinder for a well known shop and it gave trouble. The work showed chatter marks and would not grind smoothly in spite of all coaxing.

The user decided that the original gears were bad and made a new set, but the work was no better than before.

Then, in spite of the fact that the user was a pioneer in the building of gear-driven machines, the verdict was "gears."

So another machine went to the shop and this did splendid work in spite of the fact that it had just as many gears as the other. In the meantime the original machine had gone back to the builder and, when equipped with a new set of gears, ground work without a sign of chatter. So it was not a case of gears after all but only a case of *poor* gears in both instances.

In another case that I know of, the builder of a well known boring mill determined to find the cause for chatter marks in some of his work, if possible. The gear theory was firmly fixed in his mind so he started in by driving his table by a belt directly on the edge and doing away with all gearing in the drive.

But the chatter stayed with him just the same.

This cut out the notion that it was due to the gearing and he finally decided that the chatter was due to the springing of some of the parts supporting the tools and possibly the whole machine. A general stiffening of the parts followed, which did away with the chatter, although the gear drive was restored as in the first machine.

Gears have enough to answer for without being held responsible for the failings of other parts. Then, too, it makes you feel foolish after deciding that it must be gears, to have some fellow come along and prove that they have nothing at all to do with it.

So when you have a machine that chatters, it is a pretty good plan to look it over carefully to see if some part is not weak enough to allow vibration, before falling back on the gear theory.

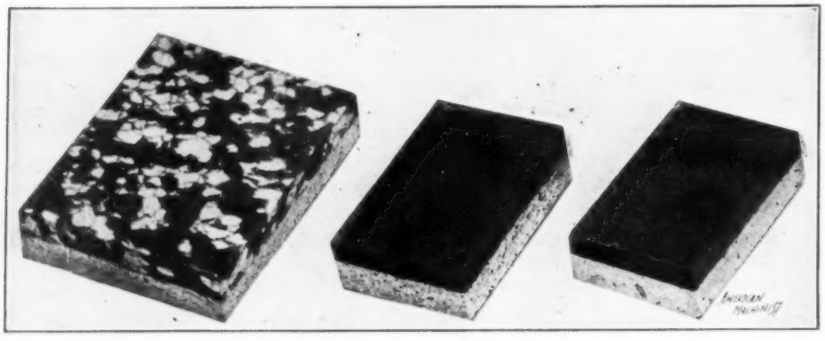
While it may be self-evident and seem common place, we sometimes seem to overlook the fact that all chatter comes from vibration or springing of the parts, somewhere. This vibration may be in the gear teeth, from imperfect shape and contact, it may be in the gear shafts or supports, it may be in the tool-holding mechanism or it may be due to vibration of the whole machine.

Stone-Wood Flooring

In discussion of a paper on factory floors presented at the last convention of the National Association of Machine Tool Builders, Henry Hess referred to a floor used by him with success in the German Niles factory. The following

additional information has been given us by Mr. Hess.

This flooring consisted of a plastic mass spread over an under floor of concrete. It is known as Torgament stone-wood flooring. It is composed of Grecian cement (magnesite), asbestos, talcum and sawdust, with a binder of chloro-magnesium lye. The material is manufactured in powder form and transported in bags to the place where it is to be used. There the material is mixed with the lye to the consistency of a thick paste and is then spread with a trowel or by other means. There are usually two applications, the first a coarser and cheaper composition than the second. The latter is denser, has a better appearance and is colored to suit. See the illustration of three small pieces of such a floor covering. All have the lower layer white in color, while the upper surface of one is dark gray, of another maroon, and the third variegated, white, black and maroon.



SPECIMENS OF TORGAMENT FLOORING

The under floor upon which this stone-wood covering is placed may be either concrete, brick, plaster, planking or the like. It is usual to cover the baseboard, as well as the floor, with the plastic compound.

After the material has reached a certain degree of stiffness, the floor is carefully smoothed off, then washed and waxed. After 14 days from the time of laying the floor is oiled. During the first year it should be oiled at intervals of from four to six weeks. Thereafter four applications of oil per year are sufficient. Since this stone-wood flooring has no joints, and since all exposed corners are rounded over, there are no places for accumulation of dust and dirt. The cleaning of the floor itself is an easy matter, it only being necessary to wash it with lukewarm water.

Flooring of this kind is made by several German firms. It can be laid in practically any color desired, and in a combination of two or more colors; thus it is possible to obtain decorative effects with its use. It is stated to be much warmer than terrazo, concrete or stone floors, although the heat-insulating properties are not as good as those of natural wood. It also serves to deaden sounds. In addition it is water-tight and fire-proof. In support of this last property we quote a statement of the Royal Police President of Berlin in regard to one of these compositions, given under date of March 8, 1910: "I beg to inform the manufacturers of Torgament that according to the tests undertaken by the Fire Department it has shown a good result and can be in general authorized by me as fire-proof."

A letter from the German Niles Company states that they laid their "Torgament" flooring in 1899 and that it has done good service to date, although it has been subjected to very hard wear. There has been no occasion for repairs.

In addition to the plastic form this flooring is furnished in slabs of various widths and in thicknesses from ¼ inch up to three inches. It is said to be extensively used as a floor covering on German steamships.

This type of stone-wood flooring is manufactured by several firms. The Berliner Torgament Werke, G. m. b. H., Berlin, Germany, makes the Torgament flooring mentioned above. The Deutsche Steinholz Werke, also of Berlin, makes a flooring known as "Dolomент," and the Sanstas Fuszbodenfabrik Heilbronn A. N. makes a similar material.

The price for Torgament floor in Berlin ranges for single colors and according to quantity from 5.50 to 3.20 marks per square meter (14c. to 8c. per square foot). The prices are increased about 1¾c. for varigated top surfaces.

The price for hollow moldings ranges from 0.60 to 0.30 M. per running meter (5c. to 2½c. per running foot).

The Danger of Success

BY ENTROPY

Rapid promotion is as likely a cause of individual failure as any in this country. Such is the keenness of the search for talent that employers often do not allow a young man to ripen in one position before advancing him to another. This naturally appears to some of those that are half ripe to be untrue, but my limited observation has seen rather few exceptions.

Again, the natural tendency of mankind is to advance as rapidly as possible, throwing aside every impediment, thus leaving himself in the predicament of the balloonist who threw out all his ballast to make a record for hight and had nothing to save himself from alighting in the middle of a pond.

It seems doubtful if every man ought to take every opportunity for apparent advancement that appears. It costs heavily.

First, there is responsibility. Responsibility comes to the man who will take it. The average man shirks responsibility and lives and dies poorer, but perhaps happier, than the man who rises above the multitude. It is just as natural for some men to take on the burden of responsibility as for a duck to swim. They cannot help it. But they often need pity if they carry their burdens to the dissatisfaction of others.

The assumption of responsibility places one in the lime light, and lime light does not agree with all types of men. The $5000 superintendent undoubtedly would enjoy a hot dog just as well as when he drew $1.75 per, but does not dare to sit on a nail keg and enjoy it as he did then. When a man is in the lime light his family know it and they make him conscious of his shortcomings day and night. The man who is impervious to wife and children, oldest daughters in particular, is a rare bird. The old slouch hat, the comfortable shoes, the collarless shirt, the mittens, all have to go before the tyranny of the household, and what takes their place costs more in money and ill-feeling than the increase in salary.

Lubrication

In a paper presented before the Institute of Marine Engineers, dealing with the "History and Practice of Lubrication in Marine Engines," it was observed that the best steam-cylinder oils were produced from crude petroleum. These "natural" cylinder oils were very largely used and generally gave satisfaction, but there were many cases in which they failed to do so. It was the author's impression that this was due to the presence of a carbon which was not entirely eliminated in the process of manufacture. It could be eliminated by distillation, but the distillate would be deficient in body and unsuitable for use in some cylinders. The best method was by filtration through charcoal, and the charcoal refined oils, from which the tar had been extracted, were less likely to leave deposits in the cylinders than those oils in which the tar was still present.

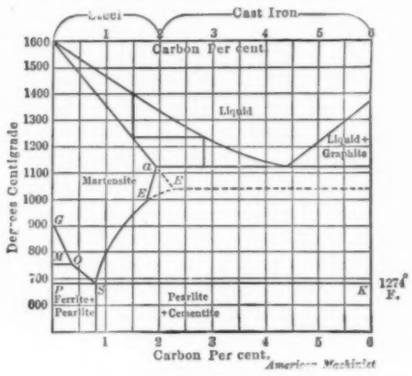
Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room. A letter good enough to print will be paid for. The value is in the idea—not the length of the letter

Hardening and Annealing Steel

While a great many shops have adopted modern methods, the majority still use the old-fashioned way of hardening and annealing steel by sight, and it seems strange that any modern or uptodate superintendent should allow this wasteful method.

Shops that are too small to warrant the buying of a proper furnace can use an ordinary horseshoe magnet for both hardening and annealing. Have the magnet hang just outside the furnace and when the steel no longer attracts the magnet cool it either suddenly or slowly as the case may require.



PHASE-DOCTRINE CHART

The chart of the Phase-Doctrine, here shown in the line cut, gives the proper temperatures for hardening or annealing steel.

Steels containing more than 0.90 per cent. of carbon lose their magnetism just above the line *S K*. While a harder steel may be obtained by quenching at line *S E*, the grain crystals that form at these higher temperatures will be larger. In heating the metal along this curve the grain crystals decrease in size until they reach the point *S*. Thus we will get a finer steel if we quench just above the line *S K*.

Steel containing less than 0.90 per cent. of carbon may be quenched at line *G O S K*. All steels lose their magnetism at line *M O*.

Hardened steel can be made soft or annealed at 1132 degrees Fahrenheit. In annealing, as well as hardening, however, we work for a fine grain crystal. Thus if we heat to line *G O S K* when annealing, a soft steel with a fine grain will be the result.

It must be borne in mind that we do not get a softer steel by heating to higher temperatures, but rather by slower cooling.

GEO. WILFERT, JR.

Pittsburg, Penn.

Finding Crack in Cylinder Head of Air Compressor and Repairing It

In visiting a shop recently we arrived at the engine room. This contained one 25-horsepower gas engine, and an air compressor, for operating pneumatic riveting machines and drills, that was rated at 80 pounds pressure constant flow. There was also a compressed-air tank, and a 300-gallon water tank to supply the water jacket of the compressor with water. The layout will be seen in Fig. 1.

While inspecting these it was noticed that at every compression stroke of the piston in the air compressor a small spray of water would shoot diagonally across the surface of the water at the top of tank, and slop over the side; see *A*, Fig. 1. We asked about the cause of this but they did not really know. On opening the relief cock *C* on air tank *B* I noticed a lot of water coming out. This accumulated in the bottom of the air tank, and was driven with the air through the line hose *D* to the pneumatic riveting gun and hampered the workman. The

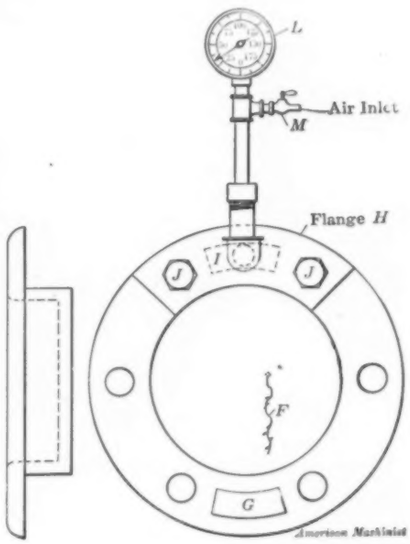


FIG. 2. CYLINDER HEAD READY FOR TESTING

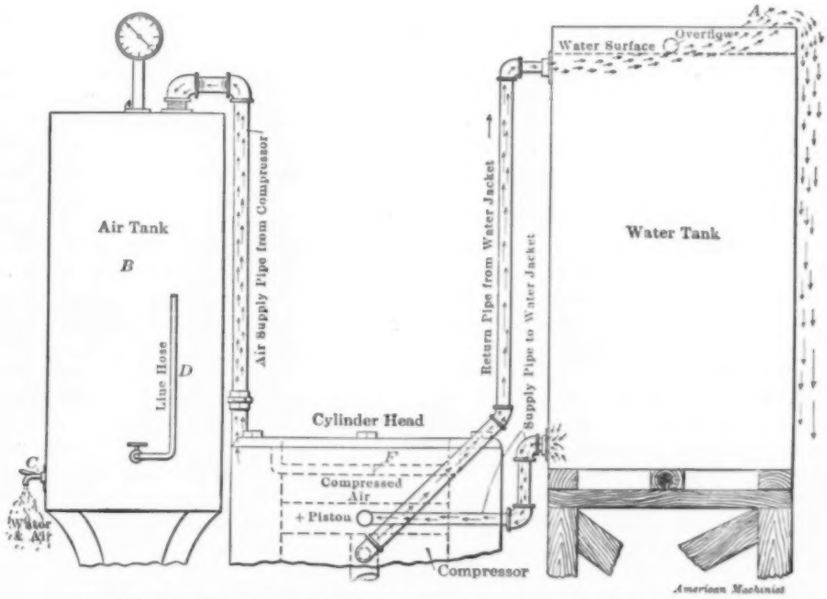


FIG. 1. COMPRESSOR OUTFIT, SHOWING CRACKED CYLINDER

water had to be let out of cock *C* at intervals of two hours.

As there was water in the air tank, and water spray, apparently caused by air, in the water tank, it meant there must be a leak somewhere between the water jacket and the cylinder. The machine had been examined for just such trouble only a week previous and a place was found that looked like a crack in the cylinder head. This was tested by filling the water jacket of the cylinder head with water but as the crack was hardly 0.001 of an inch wide no water would run out.

We, therefore, tested the cylinder head under air pressure and found that the crack, as shown at *F*, leaked enough to cause the trouble.

The method of testing the cylinder head is shown in Fig. 2. The inlet hole *G* was plugged up. Then flange *H* was made to cover hole *I* and this was secured tight with bolts *J J*, after a gasket was placed underneath. Connections for a ½-inch pipe were fitted into the flange and an air-pressure gage was attached to the end of the pipe; a tee *M* being fitted underneath it to admit the air.

The head was then filled with water to within ½ inch of the top and air was pumped into it. When the gage indicated 30 pounds pressure the water came trickling out through the crack, shown at *F*. This showed why water accumulated in the air tank. At every suction stroke the water would be sucked from the crack into the air cylinder, whereas, at the compression stroke the air would enter the crack with 80 pounds pressure behind it. It then followed the easiest way out, which was the return pipe, and thereby caused the water spray at *A*.

The crack was closed with an oxy-acetylene welding apparatus and the cylinder head was immediately put back in the compressor. It is now doing good work, minus water in the air tank, and stray air currents that disturb the surface of the water tank.

Bayonne, N. J. JOHN A. LUTHER.

An Apprentice's View of Apprenticeship

The writer has always read accounts of the various apprenticeship schemes with much interest, primarily because he was an apprentice himself under one of the most modern systems and but a short time ago finished his course.

But seldom is an article found stating the views of apprentices; either one finds an account of some new system, or else some manufacturer's experience with whatever scheme he has tried. So a short account of the ideas held by apprentices on this important subject might not be amiss. In this, however, only modern apprenticeship systems in which a certain amount of mathematics and theoretical instruction is given in connection with the shop work will be considered.

In all these schemes, however they are carried out, the main idea is to obtain thoroughly competent mechanics in the various trades.

In picking out such a place to learn in, the apprentice considers that in placing himself under the contract, as usually required, he is making reasonably sure of thoroughly learning the trade he signs for. He expects to get a variety of work and has all intentions of being faithful and industrious.

For the first year all goes well, and then there seems a lagging of interest. This often puzzles apprentices as well as employers, usually resulting in dissatisfaction on both sides. The causes are quite apparent it seems to me; first the apprentice is perhaps a little too anxious to get ahead quickly, and secondly, little attention is being paid to him other than to supply him with work. This brings me to my first point to be emphasized, namely, the need for a closer personal relation between the employer and the apprentices. At this time of his life (fifteen to sixteen years of age) the apprentice needs plenty of encouragement not only from the man directly in charge of him but from those in higher positions in the factory. The cold, businesslike, matter-of-fact way of dealing with him makes him callous to what is due the company. First the man in charge, besides knowing his business thoroughly, must have broad human sympathies and above all must be entirely open and straightforward in all his dealings with those under him.

Occasional talks by department and factory superintendents on live topics tend to keep up interest in the work and add new impetus to the boy's ambitions to learn and observe. With these meetings with superintendents, foremen, etc., can be combined a competitive system providing prizes for superiority in shop work, class work, improvement in quality and quantity of output and faithfulness to the work. These prizes, however, should not consist of money, but of tools, books, or perhaps even of simple medals having proper inscriptions and if possible signatures of those in charge. This would build up a healthy competition and gradually awaken a pride in the work as nothing else would.

Often the complaint is made that apprentices leave as soon as their time is up. For this I would suggest a plan perhaps somewhat radical, yet quite worth a trial. The main reason for a young man's wishing to go to other places to work is to get acquainted with other people, new places and new methods. It's a most natural thing, and why try to fight it off? Why not meet this desire by having an exchange system of apprentices? A number could be taken from one shop and exchanged for a like number from another shop. This would broaden out the experience of the apprentice both in his shop work and his dealings with people, beside appeasing his desire to travel a little. This would perhaps best be done at the latter part of the third year (If a four-year term is in vogue or the beginning of the fourth year, could last six to eight months, and be spent in perhaps two or three shops. For the last five months or so of his time he could be brought back to the home shop, and given a good class of work. At the expiration of his contract time there would be far less desire to leave and the company employing him would have a valuable man who would be worth something to them.

In the class work as often given, much improvement could be effected by being more careful in the selection of problems, having small classes, adapting the work to the individual needs as far as possible and *showing* the value of the mathematics and mechanics taught rather than telling about their great value. In this respect an apprentice is a peculiar creature, everything not at once apparent, must be shown and very plainly shown to be of advantage to him. Then and then only will he do much outside work.

Often the instructors in the class work are young college men who try to instil the idea that the boys under them become engineers instead of first class mechanics. Here another point comes up which must be strongly considered. Pride in being a first-class mechanic must be instilled, and with this must go the idea that a good trade well mastered makes a very honorable living and is not a thing to be shunned or avoided.

That good mechanics of all around ability are needed the country over, is a fact conceded by every large manufacturing concern. Then why not have a little more unity of purpose and harmony between the different manufacturers employing skilled mechanics, and give proper credit for a full apprenticeship, honorably served?

The ideas here set forth have been obtained by actual contact with many apprentices, not only in the shop in which I was one, but in other shops as well and are the result of both observation and inquiry.

It is hoped that at least some parts of this article will prove of value to employers of apprentices as it is a truthful exposition of present conditions.

Passaic, N. J. R. F. H.

Trade opportunities in the Philippine islands are best evidenced by the fact that for the first 10 months of this year (1910) the exports to the islands from this country practically doubled those for the same period of 1908. The total exports for the period of 1910 mentioned reached the mark of $16,418,138, among which can be found $3,300,418 manufactures of iron and steel and $226,648 for automobiles.

Discussion of Previous Question

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers

Industrial Conditions in Germany

Your recent articles on "Training Mechanics in Germany" by F. A. Halsey and John M. Shrigley and your editorial, "The Welfare of the Worker," have led to an animated discussion in a circle of friends, mechanics and technical men of various degrees of training in our field. As any public statement should be open to discussion and criticism, permit me to give my views, as one who has had an extensive experience in the United States, but is at the same time thoroughly familiar with German conditions.

Since the abandonment of a rigid apprenticeship here, the majority of men get into the trade by, in shop parlance, "picking up the trade." A young man with no previous training will get employment on some special job requiring no training. If he is ambitious, he keeps his eyes open and if after a while he sees no chance to advance where he is, will go to some other place and get a job on his nerve. If he is lucky he will work himself in, if not he will get fired and go somewhere else. I have met men, who by their own statement have seldom been on one job longer than three months, in between jobs romping the country from one end to the other. This state of affairs has no parallel elsewhere and is quite impossible in Germany where the law requires notification of one's intention to leave a place, as well as it requires the employer to notify the man in advance in case of layoff or dismissal. A man's papers will then clearly show his standing in the trade. If he is a specialist or machine hand he will be employed as such and he can, as a rule, on premium or piece work earn practically as much as the trained man. But he can never take the latter's place, a condition which is jealously guarded by a union known as, "Der Metallarbeiter Verbund" a powerful organization extending over the Empire and embracing all metal-working industries.

The rigidity of this arrangement is, of course, to the disadvantage of the untrained man, in so far as it gives him no chance to correct earlier mistakes in his career, but then again it has two sides.

To place the trade itself, not considering the higher positions, on the basis of a profession or on a scholastic basis, no trade offers sufficient inducement as yet, whether in Europe or here. It is beyond a doubt, that the economic conditions in America are far better than anywhere in Europe, but a mere statement that a man can earn so many marks or francs or shillings, meaning only so many dollars and cents, does not give the American mechanic a true and adequate idea of the conditions under which his fellow on the other side is laboring; it rather tends to prejudice him. The disadvantage of Europe lies largely in the rigidity with which a man is held in his particular class and position, in the overcrowded condition in every field of endeavor, and the resulting keener competition among men.

To comment on your article, "The Welfare of the Worker," I fear it will be met with emphatic protests from German quarters, particularly the statement that the welfare of the worker there has very little, if any, place whatever, as made in a general way, not relating to schools alone. It is true, the prime motive in establishing industrial courts, enforced mutual insurance against sickness and accident, invalid and old-age pensions, may have been to indirectly benefit the community and the State, by abolishing if only the most abject poverty and misery, but do they not work out directly to the great benefit of the individual? Then the conditions of the Gewerbe Ordnung, which are part of the civil law and are universal for all the states of the federation, with special provisions and regulations for all industries which are by their nature injurious to health, governing hours of work for men, for women and the younger workers, sanitary conditions, safety devices and provision as to preparedness and treatment in case of injury, which all work to the same end, the welfare of the worker. Besides this welfare is very much at heart in the organization mentioned above, the Metallarbeiter Verbund, and similar organizations in other branches which, in many contests have shown their ability to make their influence felt. The idea that everything in Germany is fashioned to work toward the aggrandizement of the Empire is erroneous.

It must be admitted that with us factory inspection is largely a farce, very loosely applied.. For instance, I worked in a place where a laborer had his right hand crushed, losing three fingers. His mates had tied his red handkerchief over the crushed mass. Removing it and calling for some bandages, I was finally offered, by an official of the company, some ordinary cotton waste as the only suitable thing in the place—a large factory employing from 1500 to 1800 men. You could not equal this episode in all Germany.

The staggering figures of industrial accidents in the aggregate in the United States, the great annual loss of life caused by utter carelessness, point out that much remains to be done here for the betterment of conditions. The same is shown by the frequent legal wrangles between employer and worker over questions of compensation for injury, resulting often in gross injustice to either one or the other, and greatly benefiting the legal profession.

In the matter of training mechanics, a school requiring a sacrifice of time and the expenditure of money does not and cannot reach the boys, who first of all would come into consideration as raw material to fill the rank and file in the shops, boys who either have to support themselves or at least contribute to their support.

If manufacturers find it inconvenient to train their own men, could not then a simpler and more practical method be evolved, on a strict business basis, profitable to both parties concerned? The apprentice was, with most firms, not a losing proposition.

We have now associations and organizations of manufacturers in all branches. Such an association might establish a number of fully equipped shops in various large cities, in charge of capable men with an inclination toward teaching and with a small working force of older mechanics of wide experience, among which a large number of boys could be distributed. Repetition or other work in any desired quantity could then be directed to these shops by members of the association. Would it then not be possible to instruct boys in, say, a period of two years in the rudiments of the trade, and thus make them servicable in any shop? One day per week might be reserved for lectures and such instruction as might be helpful in the work.

It would not be a case of going through the motions, as will always be true in a school attempting to teach a trade. The first plan would make mechanics, while the second will, at best, produce capable amateurs.

Tarrytown, N. Y. FRANK E. DIETZEL.

Do Gear Hobbing Machines Cut Flats?

F. O. Farwell puts the above conundrum in the AMERICAN MACHINIST on page 867, Volume 33, Part 2, and, since he uses my name seven times in the course of his remarks, I feel called upon to answer it.

I have quite exhausted the matter in previous communications and cannot think of anything new to say, but cumulative evidence is always in order. It is meaner than dirt, I know, to set one hobbing man against the other, but it is fair and here is the other party.

I have before me a pamphlet sent me by its author, Thomas Humpage, M. I. Mech. E., of the firm of Humpage, Thompson & Hardy, manufacturers of hobbing machines. The title is: "Excerpt Minutes of Proceedings of the Meeting of The Institution of Mechanical Engineers in Bristol, July 29, 1908. T. Hurry Riches, Esq., President, in the chair. By authority of the council published by the institution."

The pamphlet contains much of interest regarding the hobbing machine, original matter by Mr. Humpage and a general discussion by the members of the institution. I quote: *"Disadvantages of the Hobbing Principle.* Nevertheless, there are certain disadvantages of the hobbing principle. In the first place, owing to the spiral twist of the blades, a section of the blade normal to the axis of the blank is not a perfectly true rack, and in consequence the points of the teeth being cut are very slightly too thick. (Mr. Flanders, who claims that the hobbed tooth is a true involute, may make a note here.) Secondly, while the blank rotates continuously the cutting is intermittent, and after one tooth of the hob has taken a cut a small piece of metal escapes before the next tooth comes into action. If a hobbed wheel is examined it will be seen that the sides of the teeth show a series of small flats. By increasing the number of teeth in the hob the flats are made smaller, and if there were an infinite number of teeth in the hob it would generate a smooth curve."

Mr. Humpage then goes on to discuss various ways of grinding the rough teeth left by the hob, leaving no doubt in the mind of the reader that hobbed teeth are not considered good enough for finished work on the English side of the Atlantic.

In the discussion that followed the reading of the Humpage paper Mr. Deakin said, "It had been the experience of some motor-car builders that, after having milled out the teeth on the hobbing machine, it was necessary for them to put the wheels into an ordinary automatic gear-cutting machine and correct them." Speaking of the increased amount of metal removed by the hobbing machine as compared with the ordinary machine, Mr. Deakin said, "The metal could be removed, but when it was removed at such a rapid pace the element of inaccuracy was introduced, which all engineers desired to eliminate."

The case between the gear-hobbing men:

FARWELL VS. HUMPAGE

Farwell claims broadly and distinctly that hobbed teeth have no flats and supports the claim with some very good photographs, which, of course, show no flats.

Humpage says that hobbed teeth have flats that are so objectionable that they must be ground off before the work can be considered finished.

The principal virtue of the hobbing process is that it is comparatively new. Such machines were used 50 years ago, and have since been tried out and discarded by different concerns, but it is only recently that they have been boomed in the peculiar American way.

The hobbing machine is admitted by some to be superior to the common form for the purpose of cutting spiral-gear teeth, and at first sight it would appear to be so. But the advantage disappears when it comes down to the practical work of cutting such teeth. As a general spiral-tooth cutter the hobbing machine is inferior to the ordinary milling machine and far inferior to the Bilgram spiral-gear generator.

Mr. Farwell compares the flats with the gouges left by a milling cutter and intimates that both are defects due to forcing the feed. Not so at all. The milling cutter leaves smooth work when the feed is fine, just the condition that makes the flats stand out most prominently; and leaves hills and hollows when unduly forced, just the thing to make the hob leave such conspicuous chatter marks that the flats are broken up and obscured. When the hob is forced up to its limit the resulting surface looks as if it had been filed out with a wood rasp.

One very good way to secure perfectly smooth hobbed teeth is to send the blanks to a hobbing-machine manufacturer to be hobbed as samples.

Speaking of tricks of the trade, I supposed it went without saying that none such were known in Mr. Farwell's shop or in mine, but some of these other fellows will bear watching. Yet Mr. Farwell is careful to select gears of large numbers of teeth for his illustrations.

GEO. B. GRANT.

Philadelphia, Penn.

Burning Water

In answer to W. H. Snook's query on page 1120, Part 2, of Volume 33, as to whether the hydrogen burns in the furnace mentioned, I offer the following explanation.

When the water is turned to steam and then superheated the hydrogen leaves the water and joins the gas as told on page 775. Pure hydrogen burns with a very great heat and as city gas contains about 40 per cent. of hydrogen the object is to add some hydrogen to it as was done above. This gives a greater heat to the flame.

This is somewhat on the principle of the oxy-hydrogen blowpipe which operates as follows: Equal volumes of hydrogen and oxygen are forced into the blowpipe where they are brought together and leave its nozzle in a mixture that is lighted and hence thrown into a state of combustion.

Oxygen is a great supporter of combustion and hydrogen burns in the oxygen with a greater heat than in air, hence the oxy-hydrogen blowpipe. This blowpipe gives a flame with a temperature of about 2000 degrees Centigrade or 3632 degrees Fahrenheit. The flame is hot enough to melt platinum and quartz and can be used to fuse clay.

This I hope will clear up the question.

Plainfield, N. J. WALTER H. DROLL.

Old Machine Tools

Without wishing to detract from any of your other correspondents' views, I certainly do think that Mr. Osborne has made quite a hit in his last article.

Where the floor space is unlimited there is a practical use for old machines.

I remember a discarded pipe-cutting machine which was adapted for a bolt cutter. The machine cost $5, the changes were inexpensive to fit up to use solid dies 1/32 inch oversize for repair work. Hot-pressed blanks were tapped to fit the bolts. These rarely gave any trouble to the millwrights. The machine was automatically elastic, four or five teeth on the rack serving as a guide to the length of thread. Of course, where any considerable number of studs were needed they were bought, but a few sizes of standard dies were kept on hand for special jobs. Although as far as outward appearance was concerned they were not equal to present practice, yet they wore as well as any bought studs and could be furnished for repairs quicker than the foreman could go to the office and get an order for same from outside.

Erie, Penn. A. N. HAMMOND.

The total number of poles reported to the Bureau of the Census as purchased during the calendar year 1909, by the telegraph and telephone companies, steam and electric railroads, and electric-light and power companies of the United States was 3,739,000. There were purchased in 1909 by the same class of users 3,509,000 cross arms, 6,168,000 brackets, and 18,463,000 insulator pins.

An Expensive Small Defect

By John A. Luther

How a small cotter pin, used to lock a nut, caused an air pressure that was rated at 80 pounds pressure per square inch of constant flow to supply only 30 pounds pressure. The difficulties that were encountered in locating the trouble and the loss that was encountered by holding up work and employing machinists over-time to find the trouble and repair it.

In my line of business we are often called upon to find the reason why machinery does not work properly or up to expectations, when outwardly there is apparently nothing wrong. Often it is simply a very small defect, or say oversight in construction, that proves the most baffling to the man looking for the trouble. It seems singular that managers and owners of machine shops very rarely familiarize themselves with the apparently insignificant details of their various machines, as these often cause troubles that would be amusing if it were not for the work they cause.

The Trouble

An instance of this was an air compressor that was rated at 80 pounds pressure constant flow and was used for riveting purposes. It did not supply more than 30 pounds, and as ¾-inch rivets were being used, 30 pounds pressure was out of the question. This caused a shutting down of the shop and over-time for the machinist in trying to locate the fault and repair the same.

All of the suction and compression

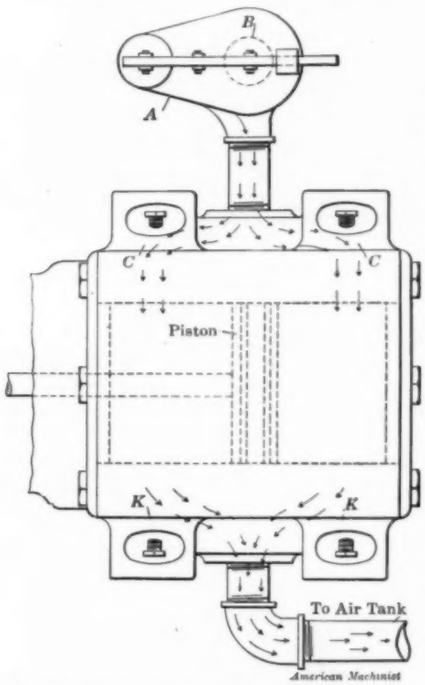


Fig. 1. Intake, Suction and Compression Valves on Air Compressor

valves were taken out, cleaned and oiled, and replaced. The compressor was then started and worked well, supplying 70 pounds pressure with ease, which was all that was needed for riveting.

This seemed to indicate that some dirt had located on the valves or their seats, and the cleaning had put the compressor in good working order again. After running about 6 hours, however, the pressure that the compressor would supply had again fallen to 30 pounds. This necessitated another shut-down.

More Careful Inspection

This time a more careful inspection of the machine parts was made. The valves were again taken out, cleaned and oiled, and replaced. When starting the compressor anew it worked to perfection. As is usual, each man concerned expressed his opinion and all felt satisfied that it was simply an extraordinary incident of some foreign matter getting into the seats of the intake valves so shortly after they had been cleaned.

Their satisfaction, however, was short lived for, after running about 5 hours, the indicator again showed only 30 pounds of air pressure. The shipping date for the job was now overdue, and every available man was used to rivet the balance of the job by hand. This gave the machinist time enough to thoroughly overhaul the compressor in their third attempt, but the results were discouraging. Although the compressor worked without a fault when it first started, it was again out of order in less than 2 hours.

Locating the Trouble

When called upon to look into the trouble, we reviewed the experiences of the machinist. This showed the tendency of men in general, and mechanics in particular, to only examine the surface of things instead of breaking away from one trend of thought and probing into other channels. Usually, they stick to the first impression as if hypnotized and follow the lines of least resistance. Thus they readily adopt another's suggestion without a shadow of a doubt as to their being wrong.

Upon examining the compressor while it was working and only supplying 30 pounds pressure per square inch, we noticed an erratic sound coming from intake valve *A*, Fig. 1, on every compression stroke of the piston. By placing my hand underneath the opening at *B*, I felt the compression coming out, whereas, only the suction should be felt. This meant that one or both of the suction valves *C* were out of order.

As the machinist had spent good valuable time cleaning the valve seats three different times, it was not a question of dirt, nor could the valve stem be rusty. Moreover, the suction and compression are quite strong enough to remove dirt from the valve seat; therefore, the only place where anything could be wrong would be in the mechanism of the valves proper.

Cotter Pin Head

When we took these out and examined them, we found that cotter pin *D*, which keeps nut *E* from turning, had an exceptionally large head, as shown in Fig. 2. The casting that covers the assembled valve mechanism has three holes at

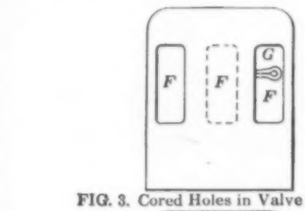


Fig. 3. Cored Holes in Valve Cover

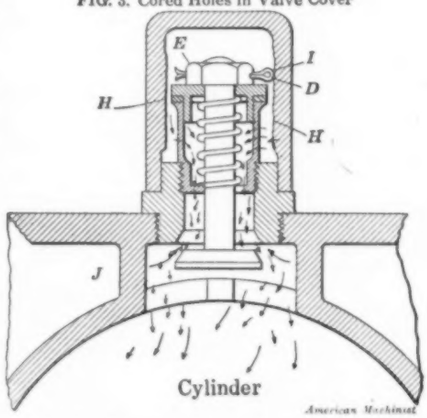


Fig. 2. Sectional View of Suction Valve

F F F. When the the cotter pin head happened to be in front of the holes, as indicated by dotted lines at *G*, it had plenty of operating room. During the working of the compressor, however, the valves revolve slightly, and the cotter pin works away from the cored holes *F F F*. It then started to rub on the unfinished surface on the inside of the valve cover, as

shown at *H*, Fig. 2, and finally struck on the high point at *I*.

Both valves had stuck the same way, and, of course, were constantly opened. This allowed all air sucked in on the suction stroke to go backward and out through the same valves on the compression stroke, instead of going through the compression valves, *K K*, Fig. 1, and from there into the storage tanks.

The compressor being of a double-acting design it left two valves in good working order to supply the tank, which accounts for the 30 pounds pressure.

The valve cutter was bored out larger and deeper on the inside to allow the cotter-pin head perfect freedom, and this was all that was required to remedy this great trouble. The compressor is now doing good service, but someone realizes the importance of a detail.

The Inspection of Threads

By Otto Stolzenberg *

The practice of Ludwig Loewe & Co., Berlin, Germany, in inspecting screw threads with a special measuring machine.

*Superintendent of apprentice training, Ludwig Loewe & Co.

A distinction is to be drawn between the testing of nut threads and of screw threads. The first form is comparatively little developed. The inspection of nut threads is chiefly limited to tests with threaded plug gages, which have on one end a thread for measuring that of the nut, while on the other end is a calipering plug which serves to test the diameter of the hole through the nut thread; see Fig. 1.

The controlling of screw threads is largely performed with gage nuts, or sizers (Figs. 2 and 3), the type shown in Fig. 3 being adjustable in order to compensate for small differences arising by wear. A much more accurate measurement, however, may be made with a special measuring machine; see Figs. 4 and 5.

This instrument has a cast-iron bed. Upon it is a longitudinal slide with scraped ways. On these ways are two adjustably arranged heads which take between their centers the screw undergoing measurement. Vertical to the lower surface of the slide is a second slide or carriage on which is mounted one of the triangles visible in the foreground of the illustration, Fig. 5. With the apparatus are also end gages, shown in the foreground of the picture, or parallel gages (Block gages, Fig. 6), also a magnifying glass.

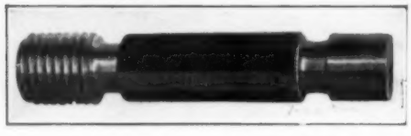


FIG. 1. NUT-THREAD GAGE

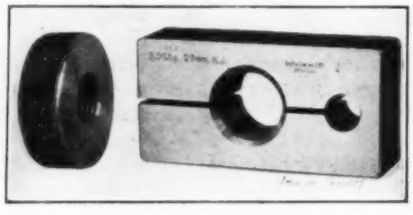


FIG. 2. SCREW-THREAD GAGES. FIG. 3.

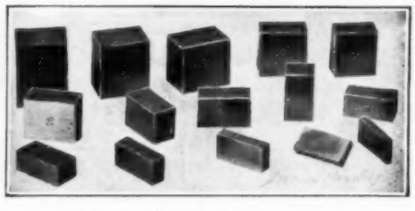


FIG. 6. BLOCK GAGES USED

Let us first follow an operation on the simple instrument, Fig. 4. The thread that is to be measured is placed between centers. In the cross carriage is inserted that triangle which exactly corresponds to the desired thread, and therefore has the same shape, the same angle, and the same rounding or flattening. The longitudinal slide is so far displaced, and the cross carriage so far moved downward that the triangle fills out the thread space, which is verified by eyesight with the help of a magnifying glass. If the opening is not filled, the thread is inaccurate.

If the purpose is also to test the pitch of the thread, the complicated apparatus shown in Fig. 5 is used. In addition to the components of the former machine, this has a fine adjusting screw, seen in the front of the figure, and a micrometer screw and indicator which are seen in the background. It is wise to test the distances between several threads, because in this way a possible error is multiplied and thus rendered more evident. Measurement is therefore twice made in the manner described. In so doing the longitudinal slide is brought, with the help of the fine adjusting screw, into the correct position. On the micrometer screw the first and second measurements are read, wherein naturally account must be taken of the inserted parallel measure. In this way is obtained the reading for the number of threads in question, and by dividing this quantity into the number of threads the pitch is found. The indicator is intended for giving a proper pressure to the measuring screw, which in both measurements must be equally strong. In taking relative measurements the needle must always come to rest on the same line, or have a corresponding movement.

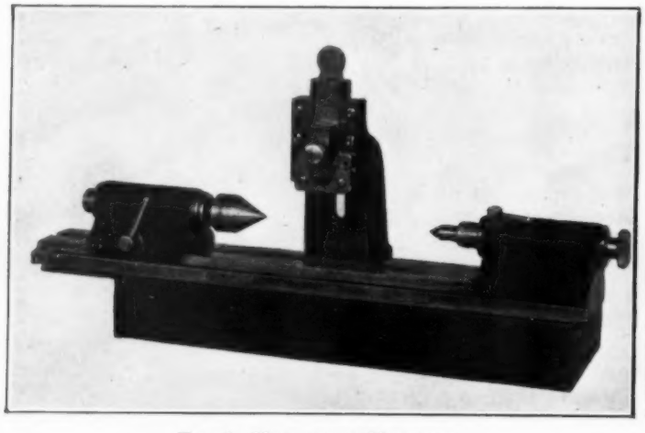


FIG. 4. MEASURING MACHINE

FIG. 5. USED TO TEST SCREW THREADS

Making Horse Shoes by Machinery

By Alfred Gradenwitz

A German automatic machine which makes completed horseshoes, with correct conical shapes, punched holes and rabbets at one operation.

The accompanying illustrations show an interesting machine for automatically producing horseshoes in finished form, manufactured by the Eisenwalzwerk Hansa, Ltd., of Bremen, Germany. This machine produces horseshoes in a single heat from iron bars cut to proper length. The working process actually consists of rolling out the horseshoes, instead of punching or compressing them. The machine requires only two men for its operation and the very small motor capacity of 7.5 horsepower.

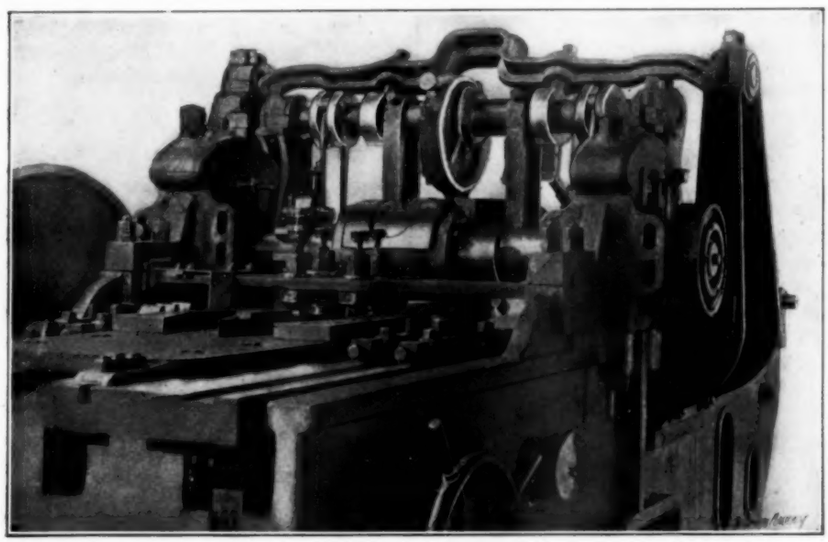


FIG. 1. GERMAN AUTOMATIC HORSESHOE MACHINE

The process consists of inserting an iron bar at the head of the machine and withdrawing it from the other end in the shape of a completed horseshoe. Referring to the illustrations, the operation is as follows:

After being cut to proper length and raised to red heat, the iron bar is located on the lower (projecting) part *A* of the matrix or die. By pulling up the crank *B*, the table is driven forward through the operation of clutch rod *C*, engaging the bevel gearing. During the forward motion of the work table, the die fixed upon the latter will pass below the two vertical rolls *E E*, fixed below the beam *D*, while the projecting core passes between them. These rolls are made to travel in the curved, hollow runways to the right and left of the projecting core, thus causing the iron bar, which is located in front of the latter, to be bent tightly around both sides; so as to assume the correct shape of a horseshoe.

As the work table continues on its forward course, the cams *F* will engage with the toothed segments *G*, thus causing the shaft *H* and the upper die *J* to rotate on the lower one. The horseshoe, inclosed between the two, will thus be subjected to a real rolling at high pressure, the maximum pressure being applied to the front part of the shoe, whereas the ends of the two legs are stretched in a backward direction. Owing to the very high lateral compression of the horseshoe, the latter is made to assume the conical shape given to the upper die; whereas, in the case of machines based upon merely punching or pressing, this part of the work has to be left to the farrier.

The upper (hollow) part of the die contains, on both sides, close to the edge, two crescent-shaped projections which are forced into the iron bar, thus producing the rabbet of the nail holes. As the work table continues its forward motion, the horseshoe is carried below the punch *K*, which is operated by the eccentric *L*. By a half rotation of the latter, the stops *M* are lifted out of the slots *N*, while the slide is brought to a standstill. The work table afterward advances another 8 inches and leaves the horseshoe on the plate P, from which it is discharged by tilting. Finally, by striking the stop *R* on the bar *C*, the coupling arrangement is reversed automatically, and the work table returns to its initial position.

The machine will make five forward and backward motions per minute, thus producing 2000 to 3000 horseshoes in a 10-hour working day.

As a matter of interest, the stock census of 1889 stated that there were then 15,000,000 horses in the United States,

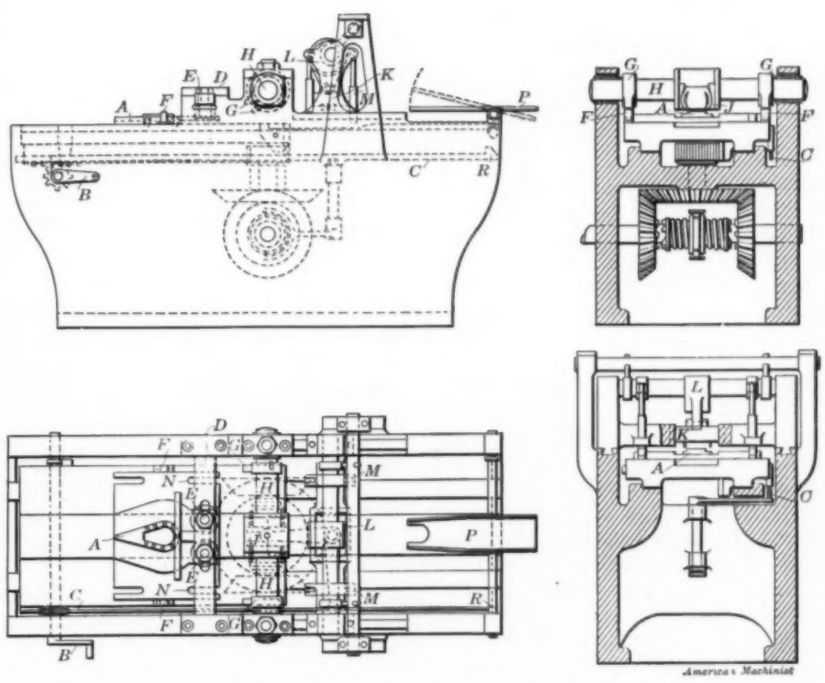


FIG. 2. MECHANISM OF HORSESHOE MACHINE

requiring 720,000,000 shoes per year, and the estimated number of horses at the present time is 21,000,000, requiring 1,000,000,000 shoes per year, despite the automobile. In 1889, the total number of horses in Germany, France, Belgium, Holland, Austria-Hungary, England, Canada, Russia and the United States was 46,980,000, requiring 2,251,100,000 shoes per year. The present total figures, 21 years later, are left to the imagination of the reader.

Herringbone Gear Testing Device

By Robert Reid*

A simple indicating device that shows inaccuracies in cutting, dirt on the teeth, burs, etc., It has eliminated gearing troubles with gears of a small, well-known air compressor.

*Mechanical superintendent's department, General Electric Company.

It frequently happens that considerable trouble is experienced in the use of gearing in machines with fixed centers between the shafts. There seem to be tight spots at various points and, due to periodic recurrence of certain sounds, we are often inclined to think that some of the gears or pinions have been cut somewhat eccentric to the axis of the shafts. This and other kinds of trouble were experienced in the construction of a certain type of air compressor made by the General Electric Company for use on trolley cars. In these compressors the gearing was of the herringbone type, made by cutting right- and left-hand spiral gears and pinions and riveting them together. It can readily be seen that a very slight error in the angle of the teeth of either gears or pinions, or in both, would cause considerable trouble when placed in the bearings, especially in those fixed or bored out in the same casting.

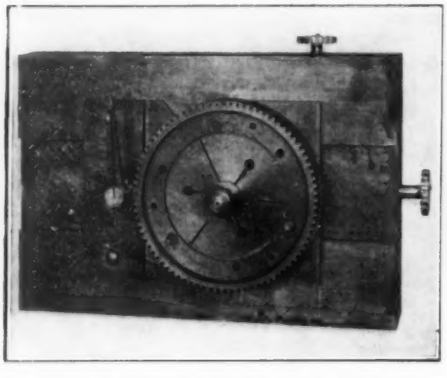


FIG. 1. TESTING THE ACCURACY OF MACHINE-CUT HERRINGBONE GEARS

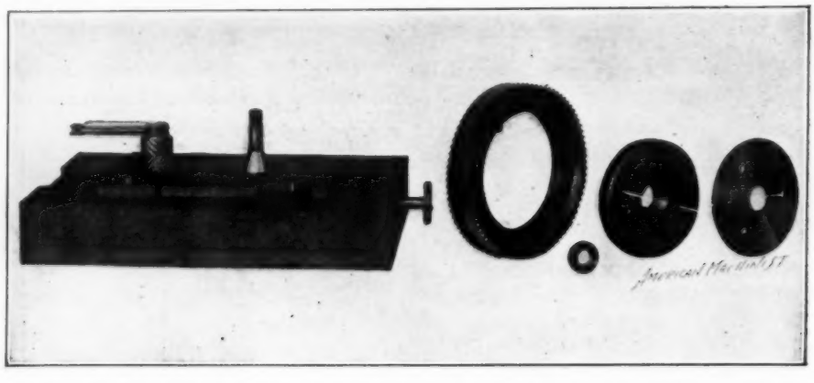


FIG. 2. DEVICE FOR TESTING THE ACCURACY OF MACHINE-CUT GEARS WITH EXPANDING CUTTERS

As a result of certain experiments to eliminate troubles of this nature the device shown in Fig. 1 was brought out for the purpose of determining the accuracy of the cutting, and also to show the amount of error in each tooth, if any should exist. The device, while intended for herringbone gearing, can readily be adapted to the testing of spur gears.

DESIGN AND CONSTRUCTION

It consists of a substantial base casting planed out to receive a slide that carries the gears to be tested, while at the opposite end is fixed a stud for the pinions. The slide for the gears is operated by the screw at the end of the base, and clamped in position by the screw at the side, a small pointer on the slide showing when they are at the right centers.

Owing to the special design of the gears shown it was necessary to provide centers for them, and these were made as shown in Fig. 2, the lower portion of the stud being tapered and disks bored to correspond so that when the circular nut which fits on the central part of this stud is screwed home it causes the split centers to expand and hold the gears central. The upper part of this stud is designed so as to accommodate a handle or wrench, by means of which the gears may be rotated by hand. It can also be seen that the gears to be tested are secured together; while the pinions, which are separate, should be as accurate as possible and are mounted on a bushing, as shown in Fig. 3, the lower pinion being made fast to this bushing, while the upper is a running fit. On the top side of the upper pinion is mounted the lever arm *A*, and above this, separated by the spring *B*, is the lever *C*, which is prevented from turning by means of the pin *D*, both being held down in position by the nurled nut. Pivoted near the outer end of the lever *C* is the pointer *E*, which extends back to the center of the stud or pinions, as may be seen in the photographs. The short end of this pointer is slotted for the pin *G*, from which it receives its motion.

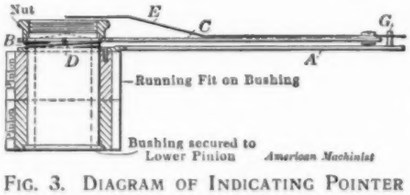


FIG. 3. DIAGRAM OF INDICATING POINTER AND PINION TO WHICH IT IS ATTACHED

DETECTS VERY SLIGHT ERRORS

Due to the ratio of the length of the lever arms we obtain an increased reading that is greatly in excess of the error. It therefore can readily be seen that a very small error is very noticeable, or if any foreign matter should be sticking to any of the teeth, the pointer immediately calls attention to it, while in one or two cases where the teeth had been burred up slightly the pointer passed entirely off the scale, thus giving the first indication that there was anything wrong with the gearing.

The apparatus is very simple, and in practice it is only necessary to place the gears on their respective studs, set them to the proper centers, and by rotating the gearing by hand we can see just how each tooth shows up. If it is all right the pointer stands at zero; whereas, if there is any variation in the teeth, or interference of any kind, the pointer immediately calls our attention to it, and also to the amount. Its use in connection with the gearing of the General Electric Company's compressors has resulted in eliminating practically all of these troubles.

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American Machinist

State Aid to Technical Institutions

The appeal of the Massachusetts Institute of Technology for additional State funds brings up several points which it is worth while to remember and to consider.

The figures show that it has spent about $200,000 a year more than it has received from the State, on the education of young men from Massachusetts alone. In other words, assuming that the amount spent in educating its young men represents value to the State, the Institute is contributing to the State far more than it receives from it.

There is no doubt as to the pioneer work that has been done by this institution in the shaping of the educational policies of other colleges in this country, the shop lecture room being an example of this kind. It was the first to equip laboratories for mining and metallurgy, for steam engineering, for testing materials of construction of standard sizes and other important innovations in college work.

If education is of value to the State and the country, and few deny the basic statement, however much they may object to the methods, the State should assist as far as necessary in bearing the burden. Whether the education be of the trades, or of the professions, or both, the State which embraces all industry, is primarily involved, although it may distribute the taxation as it sees fit according to the industries involved.

If those who pay the taxes would take a closer interest in the teachings of the colleges and trade schools, as well as other State institutions, there would be less need of appeals of this kind and less misunderstanding as to the schools and their accomplishments.

Sunday Work

A decided movement has shaped itself in several industries in the United States, having for its purpose the doing away of Sunday work in manufacturing operations. Two noteworthy industries are steel making, and more recently, cement manufacture. In both of these in years gone by it has been the habit to run plants seven days in the week. Experience has shown, however, that such industries can be carried on successfully with one day of rest for the employees, and that in the ultimate the production per unit of time worked is actually increased. In a certain cement mill the average output per kiln per day on a seven-days-per-week basis was 654 barrels. After a change was made, cutting out Sunday operation, the average daily output per kiln for four consecutive months was 667, 677, 680 and 691 barrels, showing a decided increase per unit of time for six-days-a-week operating.

This question of shutting down a plant on Sunday does not affect the machinery-building industry to any extent, for but little machinery manufacturing is actually carried out on Sunday.

There is one point, however, that is worth a certain amount of emphasis. When a plant is under continuous operation, minor repairs are made as they are required. In case a plant normally shuts down for Sunday or from Saturday noon until Monday morning, there is a tendency to postpone repairs until the hours of shutdown. In very many cases these repairs can be made just as well with a plant in operation, and in fact better, than with a plant idle. The advantages are the full operation of all machinery that may be needed to facilitate the repairs, better conditions of working as regards light and heat, provided the work is being carried on in the winter months, and usually a direct saving in labor costs, for overtime is ordinarly paid for at an increased rate.

It is very easy for a shop abuse to develop in regard to such repairs, with the result that more men work on Saturday afternoon and Sunday than is really justifiable, and to that extent break down the principle that every man in the plant has one day of rest in seven, the workmen required for absolutely necessary repairs being the only exception.

Fewer Parts in Mechanism

There is an old saying that "He who makes two blades of grass grow where one grew before, is a benefactor of mankind." The late Francis A. Pratt is credited with this variation: "He who uses one part in a mechanism to perform the work of two, is likewise a benefactor of mankind."

The truth behind all this is so well known that it may also almost be considered as axiomatic. For that very reason it is wise to point out a limitation, for all generalizations have their limitations and many of them are very important. Reducing the number of pieces in a mechanism to the irreducible minimum is wise, provided—and here comes the exception—there is no loss in the perfection of the mechanism and no increase in the difficulties or costs of manufacture.

Charles Hill Morgan

Charles Hill Morgan, prominent as a mechanical engineer and manufacturer, died at his home in Worcester, Mass., January 10. Mr. Morgan was born at Rochester, N. Y., Jan. 8, 1831, of New England parentage. His father was a mechanic and from him the son received that love of machinery and mechanical engineering which has been one of his most remarkable characteristics.

Being of limited means, his father could give him but little book knowledge, and at the age of 12 the lad entered a factory. His early education was such as was commonly the result of attendance at an old fashioned district school of more than 60 years ago. This was enhanced by a course at the Lancaster Academy.

When 15 years of age he entered the machine shop of his uncle, J. B. Parker, at Clinton, as an apprentice.

Here his natural bent found a place for expression, and he determined to study mechanical drawing. Through his efforts a class was formed for the study of this subject, being taught by John C. Hoadley, an old-time civil engineer of the Clinton mills.

Those few lessons in drawing, taken after the close of a 12-hour work day, were the most important factor in determining Mr. Morgan's mechanical career, and probably several others of that class.

When 21 years of age, Mr. Morgan was put in charge of the Clinton Mills dye house. This was in 1852. He devoted himself to the study of chemistry with great zeal and filled his new position with entire success, gaining valuable experience in the management of subordinates.

For a long time Mr. Morgan was draftsman for the Lawrence Machine Company. Later, from 1855 to 1860, he was mechanical draftsman for the distinguished inventor and manufacturer, Erastus B. Bigelow. In association with him and Charles H. Water, the agent of the Clinton Wire Cloth Mills, Mr. Morgan received during this period a valuable training and its results showed in his after successes.

As a result of the inventive turn given his mind by close association with inventors and investigators, Mr. Morgan began to delve for himself.

His first invention of note was a system of designing and constructing cam curves for looms. This system proved of great merit and was later the subject of an interesting paper read before the Worcester Polytechnic Institute and subsequently published by Mr. Morgan in pamphlet form.

Forming a partnership in 1860 with his brother Francis H. Morgan, he was for several years engaged in the manufacture of paper bags in Philadelphia, and during a part of this time a paper mill was operated by the firm near Coatesville, Penn. Previous to this time the imperfections in machinery had made paper-bag making in the United States anything but a success. Mr. Morgan perfected the equipment so that the business was placed on a commercial footing in the United States.

His Worcester career dates from 1864, when Hon. Ichabod Washburn found himself in need of a superintendent for his wire works there.

Four years later, when a joint-stock company was formed and incorporated under the name of Washburn & Moen Manufacturing Company, Mr. Morgan was made general superintendent of the works. While in the employ of this company he made many trips to Europe for the purpose of visiting the mills of England, Belgium, Germany, France and Sweden, and inspecting their methods of manufacture.

CHARLES HILL MORGAN

He was for 11 years one of the company directors and was closely identified with its growth from small beginnings to its present vast proportions. An advanced step in the wire business, for which Mr. Morgan was responsible, is the continuous rod-rolling mill. Designed and originally constructed in Manchester, England, by George Bedson, it was imported to Worcester by Mr. Morgan, who found many imperfections in it, which seriously interfered with its production of rods. This rolling mill was introduced into Worcester mills in 1869.

Nine years after the construction of the Bedson mills, a third mill from new designs furnished by Mr. Morgan, was built on the Belgian and continuous plans. This mill, the result of Mr. Morgan's studies, was known as the combination mill. The third improvement was the invention by Mr. Morgan of an automatic rod reel of the pouring type.

This was completed and gave a successful test in March, 1886. The automatic "laying" reel, now in common use in nearly every rod mill in the world, was the joint invention of Mr. Morgan and F. H. Daniels, another inventor of Worcester.

After 23 years of continuous service with the Washburn & Moen Company, Mr. Morgan resigned his position as general superintendent in 1887. He had previously founded the Morgan Spring Company, which came into existence in 1881, and now devoted his entire attention to its development. From the manufacture of steel springs only, the scope of the business was enlarged into a general wire-mill business.

Four years later, in 1891, the Morgan Construction Company was incorporated to manufacture rolling-mill equipment and wire-drawing machinery. The work of Mr. Morgan and his associates in this company has been most successful and their designs of machinery have been widely adopted.

Beside his executive work, Mr. Morgan found time to become interested in the Worcester Polytechnic Institute, with which he has been connected in an official capacity for many years. He was, up to the time of his death, a trustee of the corporation, as well as being one of the active workers on the shop committee of the Institute.

He became a member of the American Society of Mechanical Engineers in 1881, the year following the society's establishment. He served as manager from 1884 to 1887, and was honored by an election as president of that society for the term 1899-1900. He was also a member of the American Institute of Mining Engineers.

His ability as an engineer was recognized by the United States Government in 1890 by appointment to membership in a committee of three to pass upon relative merits of special gun-making machinery for the Navy Department.

While an engineer of exceptional ability and wide-spread influence, he has always been unassuming and never made the least effort to obtain recognition. He had a large circle of friends in Europe, where he spent much time in travel. In 1900 Mr. Morgan was elected to honorary membership in Société des Ingenieurs Civil de France, and he was for years a member of the British Iron and Steel Institute.

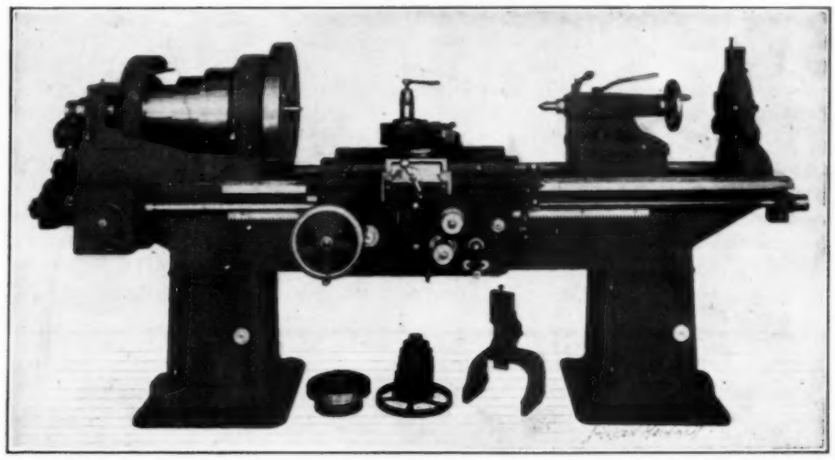
For the last few years declining health necessitated his relinquishing to a large extent the activities of his profession, and he has devoted such effort as he could command to the development of his dairy farm at Hillside, Boylston.

His principal monument is the large number of young men he has helped. He was never too busy to see a young man and none ever left his presence without being richer and stronger in ambition and courage.

Shop Equipment News

A 20-inch Engine Lathe

The accompanying halftone shows a new 20-inch cone-head lathe made by the John B. Morris Machine Tool Company, Cincinnati, O. The drive is through three-step cone and double back gear. The double gear keyed to the cone pulley meshes with the sliding gears on the back-gear quill and the pinion of the back-gear quill meshes with the face gear which is keyed to a flange on the spindle outside of the front spindle bearing. This method of driving makes it impossible to lock the cone pulley to the spindle in the usual manner and this is accomplished by means of a pin operated from the small end of the cone. The headstock bearings are tapered and ring oiled. The headstock boxes are solid bearings bored the same size front and back. The thrust of the lathe spindle is opposed by a hardened tool-steel washer. The end play of the spindle is adjusted first after which either the front or rear box may be adjusted independently. The spindle is made of high-grade crucible steel and is bored 1⅝ inches. The nose of the spindle is 3½ inches in diameter and serves as a pilot for the faceplate or chuck plates which screw direct into the face gear. The largest diameter of the front spindle bearing is 3⅜x5⅛ inches in length. The cone pulley has three steps for 4-inch belt and a double-back gear gives ratios 4.4 to 1 and 18 to 1. The speeds are arranged in geometrical progression. The lever shown below the apron provides a positive feed for rough chasing all threads with the ordinary rack feed to preserve the threads of the lead screw for finishing. Provision is made to keep the rack and screw feeds out of engagement at the same time and also for reversing the cross and longitudinal feeds in the apron. A chasing dial is provided for catching all threads without stopping the lathe or reversing the lead screw. Threads from 2 to 72 per inch, including 11½ pipe threads, can be cut. The semi-quick change gives three changes of feed for every change of gears and is obtained by moving a lever. The feeds range from 0.005 to ½ inch per revolution of spindle. The lathe swings over ways 20¾ inches and 12½ inches over the carriage. When the tailstock is flush with back end of bed the 8-foot lathe will turn 4 feet 5 inches between centers but the tailstock may be overhung permitting a length of 4 feet 10 inches between centers. The tool post will take a tool ¾x2 inches. The 8-foot lathe, as shown, weighs approximately 3700 pounds.



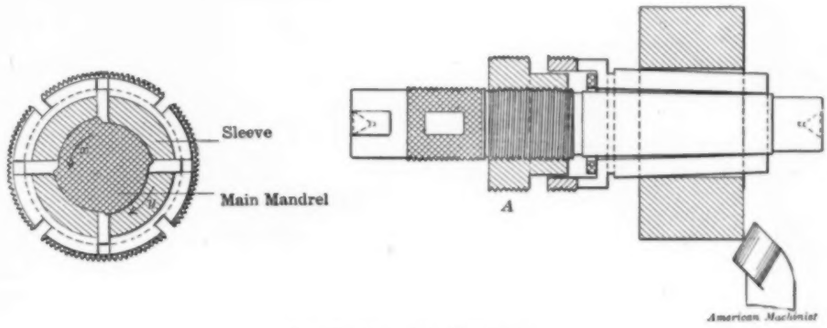
A 20-INCH ENGINE LATHE

ANY and all new or improved machines, tools or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here — the machine shop news.

A more full and detailed description will be given — when it is real news — if it can appear here first — before it is sent to other papers. ALL descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German

An Expanding Mandrel

The line cut shows an expanding mandrel manufactured in Sweden and handled in this country by the Roren Drop Forge Company, 258 Broadway, N. Y. It consists of an internal tapered mandrel with a series of external cam surfaces which fit a similar series of internal cam surfaces formed on the inside of a sleeve. The sleeve is slotted from end to end with the exception of a very small part at the end of each slot, the object of which is to keep the sleeve from falling apart.



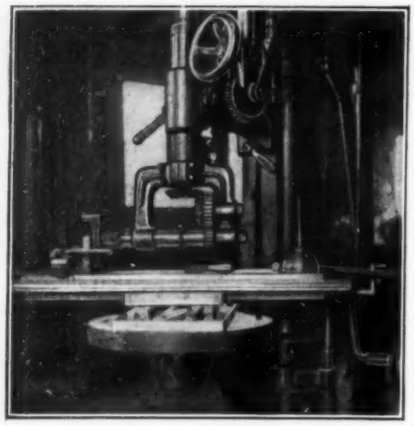
AN EXPANDING MANDREL

Externally the sleeve is cylindrical. In use the work is slipped on the sleeve and the work and sleeve are forced up on the tapered internal mandrel. A slight twist of the sleeve and work to the right, the internal mandrel being stationary, brings the cam surfaces into play and they expand the sleeve and cause it to grip the work. The cutting friction of the tool tends to tighten the grip of the mandrel on the work. To remove the

work, the nut *A* is forced against the sleeve, drawing the internal mandrel out of it.

A Keyway Cutting Attachment

The halftone shows a drill press attachment, for cutting keyways, end milling, etc. The body of the attachment is clamped to the quill of the machine and a bevel gear mounted in the end of the drill-press spindle drives the cutter arbor



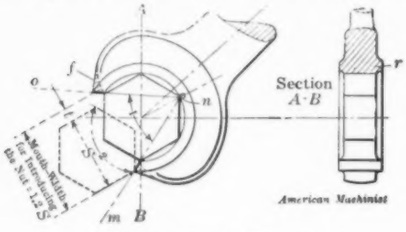
A KEYWAY-CUTTING ATTACHMENT

of the attachment through a train of gearing.

The work is secured to the slide clamped to the drill-press table. The attachment is made by the Ritter Machine Company, Sedala, Mo.

An Open-End Wrench

A wrench has recently been put on the market by Paul Schnieder, Brunswick, Germany, embodying the following described principle. It retains the old wrench form in general, but the ends and sides of the jaws are built out as guides, to aid in taking hold of the nut. The essential feature consists in the fact that the guides lie outside of the jaws proper,



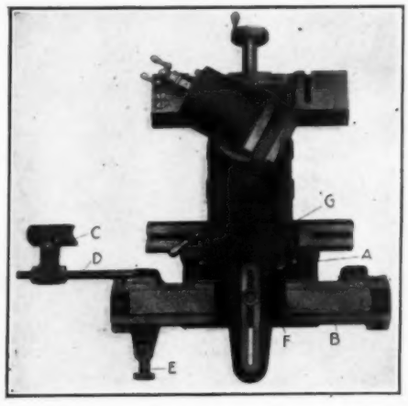
AN OPEN-END WRENCH

which remain as usual. On each side of the wrench is a circular beveled chamfer whose outside diameter is as large as that of the nut from corner to corner. Also the front faces of the jaws are beveled away at an angle indicated by *m-n-o* in the figure. The width *t* of each bevel, as projected on the line joining the front of the jaws, may properly be 20 per cent. of the inside width *S* between the jaws. When the nut is caught in the bevel it slides into place. Angle 1 is twice as acute as angle 2, therefore, the edge of the nut slides on the sides of this angle easier than on the other. The same advantage is attained through the side chamferings if one wishes to take hold of the nut from above, that is to say, along the axis of the bolt.

Taper Attachment for the Lathe

The illustration shows the taper attachment that the Willard Machine and Tool Company, Cincinnati, Ohio, is applying to its engine lathes when so desired. The attachment may also be readily applied to any of this company's lathes now in use as the carriages in all cases are jig-drilled for the reception of the bolts which hold the device in position.

The bracket *A* which is secured to the back of the carriage, is provided with a dovetail guide along which the attachment proper with the adjustable taper bar *B* on top, may be slid to any desired location, to suit the position and length



TAPER ATTACHMENT FOR THE LATHE

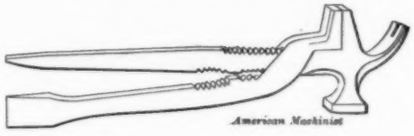
of the taper to be turned on the work. The clamp *C* which is attached to the rear Vee, and the threaded rod *D* with its two nurled nuts, facilitate the longitudinal adjustment of the bar and hold the appliance securely to the bed. Rod *D* is screwed into the lug shown and a similar lug is provided at the other end to enable the holding rod and clamp *C* to be applied at that end when it is required to operate the taper attachment at the extreme end of the bed as would be the case with long work.

The guide bar *B* swivels on the lower plate and the final adjustment in setting to any given taper is effected by means of a screw actuated by nurled knob *E*, the threaded portion of the screw passing through a swiveling nut screwed to the under side of the attachment. Graduations at the end of the attachment allow it to be set for tapers in inches per foot or in degrees, the maximum taper secured being 3 inches per foot or an included angle of 22½ degrees.

The shoe *F* which slides along the bar *B* and controls the cross slide, is provided with a taper gib as is also the main supporting bracket *A* in which the attachment is carried. A third taper gib is fitted to the extension *G* which connects the cross slide with the guide shoe *F*. In operation the tap bolt shown in the top of the cross slide is, of course, removed after the tool has been set approximately to position, and the slotted extension then clamped by its bolt to the shoe *F*.

A Combination Tool

The line cut shows a combination hammer, tack puller, box opener, monkey wrench, pipe wrench, screwdriver, etc.,

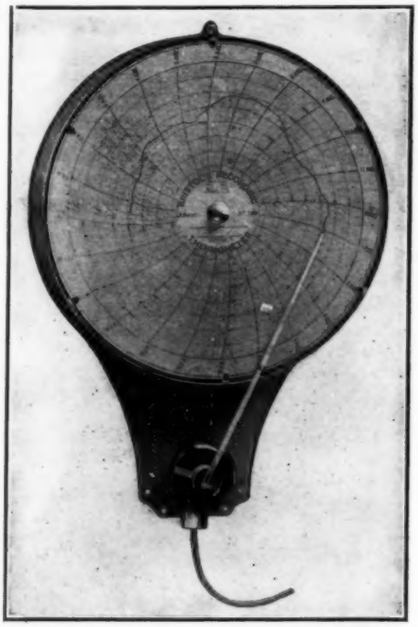


A COMBINATION TOOL

made by the Perfection Tool and Accessory Company, 1777 Broadway, New York.

Bristol Compensated Gas Filled Recording Thermometer

The new compensated gas-filled recording thermometer, shown herewith, has recently been developed by the Bristol Company, Waterbury, Conn., for recording the lower ranges of temperature, such as atmospheric temperatures, temperatures of water, temperatures of



COMPENSATED GAS-FILLED RECORDING THERMOMETER

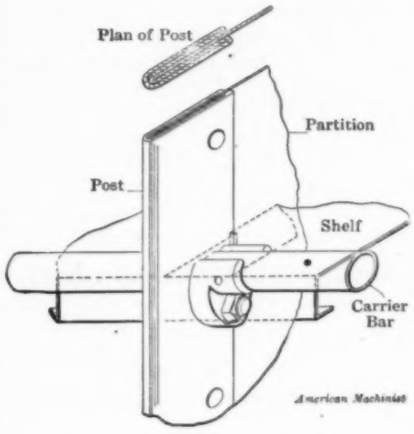
brine in refrigeration systems, etc., and found satisfactory in numerous tests. These thermometers are equipped with a patented compensating device which automatically corrects for changes of temperature at the recording instrument.

They are also equipped with sensitive bulb and flexible capillary connecting tube and a patented pressure tube, as shown, the sensitive bulb and flexible connecting tube, and spiral pressure tube all being filled with an inert gas under pressure. Changes of temperature at the sensitive bulb cause corresponding changes in the pressure of the confined gas and these changes in pressures are measured and recorded by the recording instrument.

Fireproof Stock Racks

The Manufacturing Equipment and Engineering Company, Boston, Mass., is placing on the market a fireproof stock rack, which is easily adjustable, permitting various distances between shelves and sizes of bins; a wide range of loads, stable construction independent of any attachment to the building and great accessibility with interchangeable parts.

The line cut shows the construction at the junction of the partition with the shelf and is self-explanatory.



CONSTRUCTION OF THE RACK

A Lubricant for Roller Bearings

The Royersford Foundry and Machine Company, Royersford, Penn., is placing on the market a special roller-bearing lubricant under the trade name Rollerine.

A New Die Casting Machine

The Soss Manufacturing Company, 435 Atlantic avenue, Brooklyn, N. Y., is building a machine for making die castings of the usual metals used for this purpose.

Charles E. Pollard

Charles E. Pollard, designing and erecting engineer for the E. W. Bliss Company, died at his home in Brooklyn, N. Y., December 16, 1910.

Mr. Pollard was born in Leeds, England in 1857. His parents came to America when he was very young, and

CHARLES E. POLLARD

settled in Hartford, Conn., where he received his schooling, and later became an apprentice at the Pratt & Whitney Company's shop, learning the machinist trade, which he followed for some years, and later became a contractor at these works.

About 1880 he entered the employ of the Stiles & Parker Press Company at Middletown, Conn., where he soon became a contractor, and later on, superintendent of the works. He held this position until 1890, when the Stiles & Parker Press Company was absorbed by the E. W. Bliss Company. At this time he removed to Brooklyn, N. Y., entered the employ of this company, and remained with them until his death. This covered a period of 21 years, during which time he occupied various important positions, going to Europe several times to erect large plants. In later years, he traveled quite extensively.

He is survived by a widow. His remains were taken to Burlington, Vt., for burial.

The Latest Selden Patent Decision

Of extreme interest to automobile manufacturers, and particularly on account of coming during the great annual show of the licensed makers is the latest decision in regard to the Selden patent. The decision was handed down by Judge Noyes of the United States Circuit Court of Appeals, and reverses the decision of the lower court. It describes the engine as the main feature of the Selden automobile patent, and states that the drive element dates back at least as far 1879. Gas engines were also old at that time, and liquid hydro-carbon engines, both of the compression and non-compression type, were not novelties. Practically speaking, there were two types of gas engine then in use, the so called Brayton constant-pressure engine, and the Otto engine. Selden chose the former on which to apply the ideas that constituted his patent. Judge Noyes declares that if Seldon had placed his patent on the Otto engine it would have covered the automobile. He says further:

"The patent was applied for in 1879 and granted in 1895. For over sixteen years the application lay in the Patent Office, and the applicant took full advantage of the periods of inactivity permitted by the rules and statutes. It is apparent that he delayed just as long as possible the issue of the patent to him. During this long time the automobile art made marked advances along different lines, and when, in 1895, the patent was granted it disclosed nothing new.

"Others had then made the patentee's discovery, and had reduced it to practice in ignorance of what he had done. While he withheld his patent the public learned from independent inventors all that it could teach. For the monopoly granted by his patent he had nothing to offer in return. The public gained absolutely nothing from his invention, whatever it was. From the point of view of public interest it was even better that the patent had never been granted.

"It is urged that we should favorably consider the patent on account of the delay in the Patent Office, and should seek to avoid giving it a broad construction, and should permit the alleged abuse of the law to weigh against the standing of the complainants in a court of equity. But the patentee acted wholly within his rights. He merely took advantage of the delays which the law permitted him.

"He followed strictly the statutes and rules of procedure, and the courts cannot exact a greater amount of diligence from him. When the patent was granted under the law it became entitled to the consideration accorded to any other patent. If the statutes and rules permit unnecessary delays they should be changed, but we reject the view that this court owes

any duty to relieve against their operation. This patent, even if it be useful only for tribute, must be viewed without prejudice and with absolute judicial impartiality.

"While the conclusion of non-infringement which we have reached leaves the patentee empty handed with respect to the patent for the short time it has to run, it cannot be regarded as depriving him through any technicality of the first reward for his labors. He undoubtedly appreciated the possibilities of the motor vehicle at a time when his ideas were regarded as chimerical. Had he been able to see far enough, he might have taken out a patent as far reaching as the Circuit Court held this one was. But, like many another inventor, while he had conception of the object to be accomplished, he went in the wrong direction.

"The Brayton engine was the leading engine at the time, and his attention was naturally drawn to its supposed advantages. He chose that type. In the light of events we can see that, had he appreciated the superiority of the Otto engine and adapted that type for his combination, his patent would cover the modern automobile. He did not do so. He made the wrong choice, and we cannot, by placing any forced construction upon the patent or by straining the doctrines or equivalents make another choice for him at the expense of these defendants, wh oneither legally nor morally owe him anything.

"The decrees of the Circuit Court are reversed, with costs, and the causes remanded, with instructions to dismiss the bills, with costs."

This practically says that Mr. Ford and others owe nothing to the Selden patent.

Unless the Association of Licensed Automobile Manufacturers, through the Columbia Motor Car Company and Mr. Selden decide to push the case to the United States Supreme Court for final decision, this now famous patent controversy will be over.

Increasing Shop Capacities

Metal Working

News items for the sales department — where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip — facts

NEW ENGLAND

The Leavitt Machine Company, Orange, Mass., will erect a two-story addition.

The machine shop of George F. Day, Boston, Mass., was badly damaged by fire.

The Vanadium Metals Company, East Braintree, Mass., will erect a foundry at Groton, Conn.

The Lake Torpedo Boat Company, Bridgeport, Conn., is building an addition to its machine shop.

The Improved Paper Machinery Company, Nashua, N. H., will shortly add a machine for large gear cutting.

The plant of E. S. McLaughlin & Co., manufacturing jeweler, Providence, R. I., was badly damaged by fire.

The Brunelle Boiler Company, 10 Coburn avenue, Worcester, Mass., expects soon to build additions to its plant.

Bradford Durfee Textile School, Fall River, Mass., is to erect an addition to the machine shop and dyeing department.

A two-story addition to the Derby & Ball shop, Bellows Falls, Vt., is being built for the manufacture of scythe snaths.

The Warren cotton mills, Warren, Mass., will build an addition to the cloth room, new machine shop and new weave shed.

C. S. Parris, 7 Providence court, Boston, Mass., is in the market for a bolt and nut machine, ¼ to 1½ inches in capacity.

The Steel & Johnson Manufacturing Company, Waterbury, Conn., manufacturing small brass goods, will erect a four-story addition.

It is reported the Massachusetts Saw Company, of Chicopee, Mass., is contemplating the removal of its plant to some other locality.

Bigelow, Kennard & Co., silversmiths and jewelers, Boston, Mass., are having a new plant erected, into which they will move when completed.

The Boston & Maine Railroad has secured options on site at Lowell, Mass., on which it is proposed to erect large repair and car-building shops.

MIDDLE STATES

The Mack Motor Car Company, Allentown, Penn., is erecting a new workshop.

The Youngstown (Ohio) Bronze and Foundry Company is erecting a new shop.

The Troy Laundry Machinery Company will erect a five-story addition to its plant on Twenty-second street, Chicago, Ill.

E. T. Heite & Co., Dover, Del., is equipping a new machine shop with modern tools.

Berrick & Meyer will build an iron-girder plant at 350 Abbott road, Buffalo, N. Y.

The Pittsburgh Machine Tool Company will erect a new plant at Copeland, Penn.

The Manistee (Mich.) Iron Works will probably double the capacity of its plant.

The Medina Foundry Company, Medina, N. Y., is erecting an addition to its plant.

Work has been started on a new factory for the Marshall (Mich.) Furnace Company.

The Canton-Hughes Pump Company, of Canton, Ohio, will erect a new plant at Wooster, Ohio.

The electrical supply plant of Julius Andrae & Sons, Milwaukee, Wis., was destroyed by fire.

The Union Metal Manufacturing Company, Canton, Ohio, making metal lamp posts, etc., will erect a new plant.

The Continental Motor Manufacturing Company, Muskegon, Mich., is ready to erect a new four-story factory.

The J. L. Clark Manufacturing Company, Rockford, Ill., is erecting a new plant for the manufacture of tin cans.

The Economy Motor Car Company, of Joliet, Ill., which is seeking another location, will probably go to Beloit, Wis.

Contract has been awarded for the construction of a new plant for the Puritan Machine Company, in Detroit, Mich.

The Massillon (Ohio) Foundry and Machine Company will require new machinery to take care of increased production.

The Hunt-Helm-Ferris Company, Harvard, Ill., manufacturing hay tools, tank heaters, etc., is considering the erection of a new factory.

The Rumely Company, of La Porte, Ind., is planning to build a branch factory at Des Moines, Iowa, for the manufacture of threshing machines.

The capital stock of the Ralston Steel Car Company, of Columbus, has been increased from $1,000,000 to $2,500,000 to provide for additions to its plant.

Bates & Edmonds have acquired a location at Lansing, Mich., and in a short time will start the construction of a plant for the manufacture of power plows.

The Columbus Chamber of Commerce, of Columbus, Ohio, is making an effort to have the Shelby Tube Company, of Shelby, Ohio, remove its plant to Columbus.

The Seamless Pressed Steel Company has taken over the plant formerly occupied by S. A. Arthur Company, at Red Key, Ind., and will soon commence operations.

The Laporte (Ind.) Meter Company has been incorporated with $150,000 capital to manufacture gas meters. Incorporators, W. F. Wilkins, E. Scott, E. H. Scott.

The Rochester (N. Y.) Gas Engine Company, whose plant recently burned, has taken temporary quarters in the Michael building. Expects to rebuild plant in the summer.

The capital stock of the Columbus Mill and Mine Supply Company, of Columbus, Ohio, has been increased from $75,000 to $125,000. The new capital will be used in enlarging the business.

The Greyhound Motor Company, Buffalo, N. Y., has been incorporated to manufacture and deal in motor vehicles, engines, etc. Capital, $50,000. Incorporators, W. C. Chadeayne, G. A. Getter, F. B. Baker.

The Velie Engineering Company, Moline, Ill., has been incorporated to manufacture electric motors, engines, automobiles, etc. Capital, $200,000. Incorporators, W. L. Velie, L. M. Fuller, O. E. Mansur.

The Standard Welding and Machine Company has leased a building at 951 Main street, Buffalo, N. Y., for the manufacture of sheet-metal specialties, and will commence operations in the near future.

The Bessemer Gas Engine Company, which has just completed the erection of an addition to its foundry, at Grove City, Penn., is now erecting a new blacksmith shop for which equipment will be needed.

The Klenke Pneumatic Suspension Company, New York, has been incorporated to manufacture and repair vehicles, cars, engines, etc. Capital, $100,000. Incorporators, W. H. Klenke, T. A. Klenke, M. S. Brown.

The Electric Appliance Company, Toledo, Ohio, has been organized to manufacture and sell electrical appliances and equipment. Incorporators, Mark Knabenshue, M. V. Girkins, Wesley S. Thurston, Jr., etc. Capital, $10,000.

The Columbia Wire and Iron Works, Chicago, Ill., has been incorporated to manufacture and deal in iron and wire and specialties. Capital, $20,000. Incorporators, Edward Markham, Harold Coleman, Benj. E. Roodhouse.

W. K. Bromley, of Indianapolis, Ind., and G. O. Simon, of Dayton, Ohio, and others, have purchased the plant of the Parry Auto Company, at Indianapolis. New company will be incorporated and manufacturing facilities increased.

The Motor Safety Crank Company, New York, has been organized to manufacture motors, engines, accessories, etc. Capital, $50,000. Incorporators, Mason G. Worthen, 164 West Eighty-fifth street; F. A. Linn, 1133 Broadway, etc.

The Scott Madden Iron Works Company, which operates plants in Rushville, Ind., and Keokuk, Iowa, is planning to consolidate and locate a large plant in the Central West. Brick and tile machinery, steam shovels, etc., are the products of the company.

The New Idea Spreader Company, of Coldwater, Ohio, has decided to consolidate the woodworking and castings plant, at present located at Maria Stein, Ohio, with the plant at Coldwater. Propose to manufacture other farm implements besides manure spreaders.

The Logansport, Ind., factory of the Western Motor Works, with the exception of the foundry, will be moved from that point to Marion, Ind., where it will be consolidated with the present Marion plant. It is expected to double the capacity and output at Marion.

The Economy Automatic Mine Door Company, Canton, Ohio, has been organized with a capital of $5000, to be increased later, to manufacture and sell patented mine doors and steel gates of all kinds. Incorporators, John Wach, J. C. Skelton, H. E. Vankirk, J. J. McCall and S. F. Bowman.

SOUTHERN STATES

The Norfolk (Va.) Marine Railway will rebuild its foundry recently burned.

The estate of R. J. Holzer will establish a plant for the manufacture of tin materials, at 1029 Bienville, South New Orleans, La.

The Gottlieb-Bauernchmidt-Strauss Brewing Company, Baltimore, Md., will erect a garage on Wilkins street, near Lombard.

The Emerson Steam Engine Company will shortly begin the erection of a new plant at Alexandria, Va., on the river front between Duke and Wolfe streets.

The Lexington (Ky.) Machine Works has been incorporated to manufacture machinery, engines, etc. Capital, $12,000. Incorporators, E. B. Drake, Y. Alexander, J. P. Glenn, S. E. Drake.

The Smokeless Stoker Company, of Baltimore, Md., has plans under way for the establishment of a plant for the manufacture of its stoker. Walter F. Smith, 1611 Bank street, is superintendent.

The V. T. Grabs Company is being incorporated at King, N. C., by R. L. Duval, George E. Babcock and Albert M. Gillett, for the purpose of manufacturing sawmills, conducting general foundry and machine shop.

The Universal Machine Company, Greensboro, N. C., has been incorporated with $100,000 capital to manufacture tamping machines and deal in woodworking machinery, engines, boilers, etc. Geo. W. Pritchett, president.

WEST OF THE MISSISSIPPI

Grant Smith & Co., Spokane, Wash., will build a machine shop.

Fred Brouillet is erecting a blacksmith shop at Frankville, Iowa.

The Vulcan Iron Works, Seattle, Wash., will build an addition to its plant.

W. Cahill and C. D. Patterson, of Pettibone, N. D., will build a blacksmith shop.

The National Seed Corn Tester Company, Des Moines, Iowa, is to build a new factory.

The Virginia (Minn.) Foundry and Machine Company will erect a plant in West Duluth.

The blacksmith shop of Ferdinand Nokel, at Long Prairie, Minn., was destroyed by fire.

The plant of the Kansas City Bolt and Nut Works, at Sheffield, Mo., was burned. Loss, $400,000.

The Pioneer Tractor Company, of Winona, Minn., will erect a machine shop, power house, test shop, etc.

The Duluth (Minn.) Iron and Metal Company is said to be considering the establishment of a branch plant.

The Chino Copper Company, Santa Rita, N. M., is building a machine shop. The plant will be equipped with heavy tools.

Mr. Boggs, Wallace, Idaho, will build a commercial garage and repair station. Modern repair machinery will be installed.

The Lennox Furnace Company, Marshalltown, Iowa, is to erect new buildings in the spring for the manufacture of steel ranges.

J. G. Gulbertson, of Wichita Falls, Tex., is said to be interested in a new company formed for the purpose of establishing a plant for the manufacture of motor trucks.

The Peerless Automobile Agency will build a new commercial garage at Post and Van Ness streets, San Francisco, Cal., to cost $112,000. Modern repair-machinery will be installed.

The San Diego Electric Railway Company, San Diego, Cal., has commenced the erection of its new machine shop to cost $40,000. The plant will be equipped with all machinery needed in the repair and building of cars.

CANADA

Fire destroyed the machine shop at the Bartlett mines, Gowganda, Ont.

The plant of the Stettler Iron Works, at Stettler, Alberta, was badly damaged by fire.

The Western Bridge and Equipment Company will build a large factory at Chatham, Ontario.

G. V. Cousins, of Montreal, is the head of the Canadian Rotary Machine Company, which will locate in Montreal.

It is reported that the United States Steel Corporation has secured 1500 acres for a plant on the Grand river, near Dunnville.

E. R. Parkins, of Montreal, is interested in the National Bridge Company, which will locate a million-dollar plant in Montreal.

The city of Nelson, B. C., will install manual-training equipment in the schools. Machine-tool equipment and benches will be required.

GENERAL MANUFACTURING

NEW ENGLAND

Norwich, Conn., will establish a new pumping station.

Rutland, Mass., will install an electric-lighting plant.

Geo. C. Vaughn will erect a large leather factory in Salem, Mass.

The Soule Mill, New Bedford, Mass., is to erect a two-story picker house.

Middlesex Glass Company's plant, at Malden, Mass., was damaged by fire.

The town of West Brookfield, Mass., is to expend $30,000 for a water system.

The J. P. Renton Company, Lynn, Mass., will install a steam engine and boiler.

The Robinson-Farrel Company will establish a new shoe factory in Lowell, Mass.

Hoyt Brothers, Ware, Mass., will purchase a 50-horsepower portable engine and boiler.

W. H. McElwain Company, Manchester, N. H., will erect a new central power station.

The Johnson Palm Leaf Goods Company will erect a straw-hat factory in Dana, Mass.

The Davenport Brown Company, Somerville, Mass., requires a 42-inch veneer press.

The Wachusett Thread Company, Worcester, Mass., will erect a four-story factory.

The mill of the Rosemont Dyeing Company, Woonsocket, R. I., was burned. Loss, $35,000.

The *Worcester Telegram*, Worcester, Mass., is in the market for a motor-driven sump pump.

The George E. Keith Company, Brockton, Mass., will erect another shoe factory in South Boston.

The Heminway & Bartlett Silk Company, Watertown, Conn., is in the market for an engine indicator.

L. J. Robinson's clapboard and flooring mill, at Rochester, Vt., was burned. The mill will be rebuilt.

An eight-story factory will be erected at 300-310 Commercial street, Boston, for the United Candy Company.

The C. A. Eaton Company, Brockton, Mass., will build an addition to be used as a boiler and engine room.

The Connecticut Mill Company, Danielson, Conn., is to double the capacity of its plant. New machinery will be installed.

The Blair Veneer Company, North Troy, Vt., will rebuild its plant recently burned. All machinery is to be electrically driven.

E. B. Moore, 57 President avenue, Quincy, Mass., will purchase a 150-horsepower steam boiler and 800-foot compound air compressor.

The Lantagne Refrigerating Company, Providence, R. I., is to remove its plant from the Banigan building to 159-161 Orange street.

The Bay State Saddle Tree Company will move from Bellows Falls, Vt., to Springfield, Vt., and will materially enlarge its plant and business.

The Honodite Finishing Company, J. J. O'Hare, president, has leased the Chadwick Print Works, North Dighton, Mass., and will operate same.

The Bristol & Plainville Tramway Company is planning to make changes at its power plant in Bristol, Conn. J. E. Cockings is superintendent.

The Windham Handle Company will remove its plant from South Windham, Conn., to Willimantic, Conn. The company manufactures axe handles, etc.

The Swift River Box Company, North Dana, Mass., is installing machinery in its new building, which takes the place of the one burned a few months ago.

The E. A. McMillin Company, North Adams, Mass., manufacturer of paper boxes, has purchased land adjoining its property and will immediately build a two-story addition.

New equipment will be installed at the plant of the Trumbull Electric Company,

Plainville, Conn., including one 150-horsepower engine, direct connected to a 100-kilowatt generator, one 100-horsepower return-tubular boiler feed-water heater.

MIDDLE STATES

The plant of the Seaford (Del.) Ice Company was destroyed by fire.

The L. D. Caulk Company, Milford, Del., is installing a new steam plant.

The Shelbyville (Del.) Electric Light and Ice Company is making additions.

S. A. Cook & Co., furniture manufacturers, Medina, N. Y., are erecting an addition.

The Marion (Ohio) Dump Wagon Company is contemplating the erection of a new plant.

The Thilmany Pulp and Paper Company will erect a $250,000 plant, at Kaukauna, Wis.

The plant of the Billingsworth Steel Company, at Bridesburg, Penn., was destroyed by fire.

A new engine is to be installed in the Dover, Del., electric-light and pumping station.

A two-story boiler house will be erected for the Stroh Brewing Company, Detroit, Mich.

Fire destroyed the plant of the Peerless Furniture Company, Jamestown, N. Y. Loss, $40,000.

Fire destroyed the plant of the Ehman Mantel and Door Works, Decatur, Ill. Loss, $300,000.

The new sulphide plant of the Pioneer iron furnace, at Marquette, Mich., was burned. Loss, $10,000.

The Superior (Wis.) Box Company is contemplating the erection of a new plant at South Superior.

The tapestry mill of George Royle & Co., Frankford, Penn., was destroyed by fire. Loss, $20,000.

The Royal Packing Company, Milton, Del., is making plans for the installation of a hydroelectric plant.

The Hudson River Plaster Works is erecting a plant at Roseton, N. Y., for the manufacture of dry mortar.

The International Bridge Company, Buffalo, N. Y., will erect a power house, at Niagara and Wayne streets.

The Briggs Manufacturing Company, Detroit, Mich., making automobile bodies, accessories, etc., will erect a three-story addition.

John S. Gray, manufacturer of shoes, at Syracuse, N. Y., is erecting a four-story building and will largely increase his business.

N. I. White is contemplating installing an electric-light plant, gasolene-operated, at Ellenburg Depot, N. Y. (Post Office, Ellenburg).

The power plant of the Lorain Coal and Dock Company, at Blaine, Ohio, was almost totally destroyed by an explosion. Loss, $10,000.

The Flos Shade Roller Company, Ogdensburg, N. Y., whose plant recently burned, is receiving inducements from other cities to rebuild its plant.

Plans are being prepared for an addition to the plant of the Cunningham Piano Company, at Fiftieth street and Parkside avenue, Philadelphia, Penn.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will receive bids, January 31, for furnishing and erecting dust-collecting system.

On May 1 the Buffalo Lounge Company will take possession of the five-story brick buildings, at 588-594 Louisiana street, Buffalo, N. Y., where it will manufacture furniture.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids, January 31, for metal lockers for North Chicago navy yard as per schedule No. 3249.

The W. D. Allison Company, manufacturer of physicians' furniture, North Alabama street, Indianapolis, Ind., has purchased property in that city and will erect a large factory.

The John A. Levis Company, Rochester, N. Y., has been incorporated with $50,000 capital to manufacture paper boxes. Incorporators, John A. Levis, Wm. Henry Wood, A. Frank Warren.

The J. Henry Amt Company, Indianapolis, Ind., has been incorporated with $25,000 capital to engage in the preserving and pickling business. Incorporators, J. H. Amt, Peter Heinz, L. H. Amt.

The Richwood Clay Company, Richwood, Ohio, has been organized with a capital of $100,000 to manufacture and sell all kinds of clay products by J. A. Shipley, C. McAllister, J. B. McAllister, etc.

Proposals will be received by the Navy Department, Bureau of Yards and Docks, Washington, D. C., until 11 a.m., February 4, for a 60-ton electric traveling crane for building No. 23 at the Norfolk navy yard.

The Bingham Manufacturing Company, Cleveland, Ohio, has been incorporated to manufacture all kinds of vehicles. Capital, $25,000. Incorporators, Herbert Bingham, W. C. Rhoads, Wm. H. Gillie, etc.

The Joseph Lay Company, of Ridgeville, Ind., has purchased the Starbuck property, at Mattoon, Ill., and will install equipment and establish a branch factory at an early date for the manufacture of brooms and brushes.

The Indianapolis, Nashville & Southern Traction Company has been incorporated at Indianapolis, with $150,000 capital, to construct a railway in Indiana. Incorporators, John A. Johnston, Thos. F. Wakeland, John A. Shafer, etc.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids on February 7, for steel bolts and nuts, brass nuts, composition valves (schedule 3257), brass machine and wood screws (schedule 3256).

The William Zeitz & Son Company, Cleveland, Ohio, has been incorporated with $25,000 capital to manufacture and sell doors, frames, sash and interior finish. Incorporators, William Zeitz, William R. Zeitz, Herbert P. Kramer, etc.

The Gouverneur Mineral Company has been incorporated to develop the James J. Donovan lead mine, near Pierce's Corners, Macomb, N. Y. Preparations are being made to sink a shaft, and with the spring it is expected that a large force of men will be employed on the work of development.

A new concern, the Fireproof Film Company, has acquired a large block of land in Rochester, N. Y., and has let contract for buildings at a cost of about $200,000. A fireproof film will be manufactured. The president of the new concern is Gustav Cramer, head of the G. Cramer Dry Plate Company, St. Louis, Mo.

SOUTHERN STATES

The Newton (N. C.) Cotton Mills will put up an additional building.

Contract has been awarded for the erection of a new box factory for Becker Brothers & Sons, Baltimore, Md.

The Chattanooga (Tenn.) Sewerpipe and Fire Brick Company will install three new boilers and other equipment.

The Thornhill Wagon Works, Lynchburg, Va., will rebuild its plant recently burned. New factory will cost $200,000.

The city of Opelousas, La., will install additional equipment in its electric-light plant. Armas Durio is superintendent.

The city of Red Springs, N. C., has voted issuance of bonds for the construction of waterworks and sewage system.

The city of Lexington, Va., will vote on issuance of $75,000 bonds to increase water supply. Samuel B. Walker, Jr., mayor.

Voigt & Co., Chattanooga, Tenn., manufacturers of pharmaceutical specialties, will erect a new building at Boyce and Craven streets.

It is expected that the cotton-yarn mill, of the Roberta Manufacturing Company, of Concord, N. C., recently burned, will be rebuilt at once.

The Montgomery (Ala.) Light and Water Power Company is preparing for an expenditure of $350,000 for the purpose of increasing its capacity.

The Skinner Bending Company, of Kenova, W. Va., contemplates establishing a plant at Huntington, W. Va., for the manufacture of wheels, rims, etc.

The Oakland Mills, Newbury, S. C., has awarded contract for the construction of a four-story building to be used for the manufacture of print cloth.

WEST OF THE MISSISSIPPI

Musselshell, Mont., will install waterworks system.

The Farmers Creamery, at Waubeek, Iowa, was burned.

The Pacific Bottling Works, Seattle, Wash., will erect a new building.

The Russia Cement Company, Anacortes, Wash., is building a new plant.

Roher Brothers, of Mandan, N. D., will erect a sash and door factory.

E. I. Stanton Company, Spokane, Wash., will build a large packing plant.

The Glendale Ice Company, Glendale, Ariz., will build an ice-manufacturing plant.

J. L. Carlson, Seattle, Wash., is planning to erect a fish cannery at Tee Harbor.

The city of Chaffee, Mo., will construct waterworks. J. M. Massengill, mayor.

The Pacific Fire Proof Insulating Company, Portland, Ore., will build a new factory.

The Belle Fourche (S. D.) Creamery Company will erect a $10,000 cold-storage plant.

A cold-storage plant will be installed in the new University school addition, at Eugene, Ore.

The Wheeler Reese Company, of Seattle, Wash., will build a silo factory at Des Moines, Iowa.

B. J. Boorman, Kalispell, Mont., will build a sawmill. Modern equipment will be installed.

Fierling & Rutherford will erect a plant to manufacture auto-tire protectors, at Hamlet, Neb.

The Cascade Lumber Company, North Yakima, Wash., will make improvements in its mill.

The Dominion Oil Company, operating on section 15, near Taft, Cal., will install new equipment.

The city of Toppenish, Wash., will install a new sewer system. Bonds for $35,000 have been voted.

R. W. Bell, of Chehalis, Wash., will organize a company to build a central heating plant there.

The Brauer acetylene lighting plant, at Marshalltown, Iowa, was destroyed by fire. Loss, $5000.

The Otay Oil Company, operating near San Diego, Cal., will install new machinery on its property.

The Barber Asphalt Company will make additions to the tune of $125,000, at Des Moines, Iowa.

The main building of the Mason City (Iowa) Brick and Tile Company was burned. Loss, $25,000.

The shoe factory of Bentley & Olmsted, Des Moines, Iowa, was destroyed by fire. Loss, $100,000.

M. M. Valerius, Sutherlin, Ore., is at the head of an enterprise to build a power plant in this vicinity.

The Loughman Cabinet Company, St. Louis, Mo., will erect a two-story factory at 3401-3407 Rutger street.

The Beverly Investment Company, Beverly, Wash., will build a pumping plant of 8,000,000 gallons capacity.

C. A. Burckhardt & Co., Seattle, Wash., will establish a canning plant at Chomley, Sunny Point, Alaska.

The Tuolumne River Power Company, Groveland, Cal., will make extensive improvements in its system.

The Farley & Loetscher Company, of Dubuque, Iowa, will establish a sash and door factory in Des Moines.

L. Harbach Furniture Company, of Des Moines, Iowa, will make improvements at Fifth and Elm streets.

A. R. Abbott, El Centro, Cal., has secured a site and will build a factory for the manufacture of cement products.

Taylor & Kemp, Prosser, Wash., will increase the capacity of their flour mill. New machinery will be required.

The power house of the Minneapolis (Minn.) General Electric Company was destroyed by fire. Loss, about $500,000.

The Ward Laundry Company, Seattle, Wash., will build a new plant. Modern equipment will be installed.

The South San Joaquin Irrigation district, Stockton, Cal., has voted bonds for $1,875,000 for irrigation improvements.

The Pacific Coast Gypsum Company, Vancouver, B. C., will erect a factory for the manufacture of hard plaster.

The Gila River Power Company, Silver City, N. M., will build a hydroelectric plant of 15,000 horsepower capacity.

The Northern Produce Company, Cuero, Tex., will double its cold-storage facilities and install a 30-ton ice plant.

Moberly, Mo., is contemplating the erection of an electric-light plant. L. G. Knapp & Co., Kansas City, engineers.

The Chelan Water Power Company, Chelan, Wash., is planning for extensive improvements in its irrigation system.

The Portland Gas and Coke Company, Portland, Ore., will expend $750,000 in 1911 for improving its plant and system.

The Standard Oil Company is planning to build a refinery in the vicinity of Los Angeles, Cal.; $3,000,000 will be expended.

The Bear Creek Oil Company, operating on section 14, near Taft, Cal., is contemplating the installation of a new pumping equipment.

The Albers Brothers Milling Company, Portland, Ore., will build a flour mill and warehouse. Modern equipment will be installed.

The British Consolidated Oil Company, operating at Coalinga, Cal., is contemplating the installation of new electric equipment at its oil wells.

The Standard Laundry Company, Victoria, B. C., will build an addition to its plant. New boiler, electric machinery, etc., will be installed.

The North Idaho Pine Lumber Company, Lane, Idaho, will rebuild its mill recently destroyed by fire. Modern machinery will be installed.

The city of Georgetown (Tex.) has purchased the electric-light plant and waterworks and will expend about $32,000 on improvements.

The Riverside Artesia Water Company, Riverside, Cal., will improve its system to the extent of $200,000. Bonds for this amount have been issued.

The Southern Pacific Railroad is preparing plans for a power station to be erected at Berkeley, Cal. The company is electrifying its lines in this vicinity.

The Citizens' Lighting and Power Company has been incorporated at Aberdeen, Wash., and will operate in this section. A city franchise has been asked.

The Cuero (Tex.) cotton factory will spend $50,000 in improvements. Additional buildings will be erected, new equipment installed, also steam-heating plant.

The American Home Investment Company, Rochester, Wash., has commenced the erection of a sash and door factory. Modern machinery will be installed.

The city of Martinez, Cal., will vote bonds for $50,000 for improvements in its water front and for the construction of a city hall. Equipment will be required.

The Anheuser-Busch Brewing Company, St. Louis, Mo., will build an addition to its cold-storage plant at Los Angeles, Cal. A. F. Rosenheim, architect, Los Angeles.

The Pacific Coast Power Company will build a large hydroelectric plant at White River, Wash. The Stone & Webster Engineering Company is acting for the company.

Gorman & Co., Seattle, Wash., will rebuild their Kasaan cannery, Kasaan Bay, Alaska, recently destroyed by fire. A complete line of can-making machinery will be installed.

Secretary of Navy Meyer has recommended an appropriation of $890,000 for the erection of a coal depot at the Puget Sound navy yard, Wash. It will be of 200,000 tons capacity.

The Boise Power, Light and Traction Company, Boise, Idaho, has been incorporated for $1,000,000, and is preparing to erect a 5000-horsepower hydroelectric plant on the Payette river.

The Occidental College, Los Angeles, Cal., plans for which are being prepared by architect Myron Hunt, will install a central steam plant for the five buildings. Equipment will be required.

E. E. Goff, Portland, Ore., contemplates the erection of a 500-horsepower hydroelectric plant on the Washougal river. He has applied to the city of Camas, Wash., for an electric-light franchise.

The Brunswick, Balke, Callender Company, of Chicago and elsewhere, will establish a branch plant at Dubuque, Iowa. The concern manufactures billiard tables, bar fixtures, house refrigerators, etc.

The Pacific Power Company, Dierenger, Wash., will install two Allis-Chalmers 24,000-horsepower Francis turbines in its new power house, at Lake Tapps. Much additional equipment will be added.

Clark Hinshaw, La Habra district, near Whittier, Cal., is at the head of a newly formed citrus fruit growers' association. A new packing house will be erected and latest improved machinery installed.

The Weimer (Tex.) Water, Light, Ice and Cold Storage Company, recently organized, has taken over the electric-light plant and will make improvements. Will also install waterworks, ice and cold-storage plant.

The Muskogee (Okla.) Manufacturing Company is erecting a new plant. Woodworking machinery will be needed, including spoke and handle machine and machines for general planing and mill work. Dry kiln will also be installed.

Aaron Hill, Hoboken, N. J., is at the head of an enterprise to build a factory for the manufacture of bedsteads, springs and accessories, in the vicinity of Los Angeles, Cal. Four acres of property has been purchased and construction of buildings will soon begin; $40,000 will be expended.

The new high school, at Phœnix, Ariz., plans for which are being prepared by architect N. F. Marsh, Los Angeles, Cal., will erect a shop building for manual training with wood- and iron-working departments. A central power plant for the buildings will be constructed. Equipment will be required.

CANADA

Hespeler, Ont., will install an electric-lighting system.

The Ottawa Electric Railway is building a new power house.

Harrison, Ont., will install a complete new waterworks system.

Waterloo, Ont., will spend $50,000 on an electric-lighting plant.

St. Catherines, Ont., will spend $180,000 improving its waterworks plant.

North Vancouver, B. C., is in the market for $50,000 worth of cast-iron pipe.

The Canada Refining and Smelting Company, of Orillia, will extend its plant.

The Seymour Power and Electric Company will locate a plant at Bowmanville, Ont.

The Harvey Printing Company, of Toronto, is building a large addition to its plant.

Engine room and boiler house at Bartlett mines, Gowganda, Ont., were destroyed by fire.

The Standard Laundry Company, of Victoria, B. C., is extending its plant considerably.

Pembroke, Ont., is in the market for 6000 feet of 18-inch lapwelded or riveted steel piping.

The British Columbia Portland Cement Company is building a large plant at Princeton, B. C.

The St. Maurice Valley Cotton Company will locate a large new factory at Three Rivers, Que.

The plant of the Deacon Shirt Company, at Belleville, Canada, was destroyed by fire. Loss, $75,000.

The British Columbia Electric Company will build a large plant for developing power, at Elko, B. C.

Fire damaged the plant of the Canadian Leather Company, at Montreal, to the extent of $200,000.

Fire damaged machinery at the Norcross stone-dressing plant, at Iberville, Que., to the extent of $30,000.

The Partington Pulp and Paper Company, of St. John, N. B., will make extensive improvements to its plant.

W. Bumstead, of Owen Sound, is interested in the establishment of a large planing mill, which will be built there shortly.

Thomas Bishop, of Portneuf, Que., is head of the Montreal Paper Company, which will locate a large plant at Portneuf.

The plant of the Overland Furniture Company, at Winnipeg, was damaged to the extent of $20,000 by fire. New machinery will be installed.

The Western Manufacturing Company, of Regina, has purchased the plant of the Saskatchewan Sash and Door Company, and will greatly enlarge it.

The Maine & New Brunswick Electrical Power Company, of St. John, N. B., will build a new line to Grand Falls, where a large power plant will be located.

MINING

The Pacific mine, Eldorado county, Cal., will install a new mill.

The Contention mine, Tuolumne county, Cal., will install a 10-stamp mill.

The Veta Colorada mine, Hermosillo, Sonora, Mexico, is building a smelting plant.

The Gilt Edge-Maid mine, in the Galena district, S. D., will build a smelting plant.

The Golden Eagle mine, near Johnnie, Nev., will install a reduction plant early this year.

The Bunker Hill & Sullivan mine, Wardner, Idaho, will install new hoisting equipment.

The Tinton concentrating mill, Nigger Hill, in the Deadwood district, S. D., will be enlarged.

The Luning Gold Mines Syndicate, operating in Esmeralda county, Nev., will build a quartz mill.

The Ray Central Copper Company, Ray, Ariz., contemplates the installation of a reduction plant.

Operators of the Dutch stamp mill, Tuolumne county, Cal., will make improvements in the present stamps.

The Mascot mines, near Harrington, Ariz., contemplate extensive development. New machinery will be installed.

The Golden Reward mine, Deadwood, S. D., will increase the capacity of its 200-ton cyanide plant to 500 tons.

H. E. Cunningham, operating the Teagle placer deposits, Summit, Cal., is contemplating the erection of a plant.

The Fedrazzini Mining Company, operating near Arizpe, Mexico, is installing new equipment at its silver mines.

The Sulzer mine, Prince of Wales island, Alaska, operated by the Alaska Industrial Company, is planning for extensive operations.

The Mexican-American Smelting and Refining Company, Guaymas, Mexico, is planning to install a new concentrating equipment.

The Espiritu Santo Mining Company, Mexico City, Mexico, operating in the Taxco district, will build a cyanide plant of 150 tons capacity.

The Crawford mine, near Harrisburg, Cal., has been purchased by W. R. Price, Los Angeles, Cal. The mine will be equipped with machinery.

The Nevada Consolidated Copper Company, operating near Ely, Nev., contemplates installing two steam shovels and more dinky engines in the near future.

The Ray Consolidated Copper Company, Hayden, Ariz., will increase the capacity of its mill to 15,000 tons, almost double the present output. A blast furnace may be added in the future.

BUSINESS ITEMS

The Baird Machinery Company, Pittsburg, Penn., has opened a branch office in Masonic Temple building, Erie, Penn., F. J. McCoy, manager.

The Michel-Kurze Company, with offices in the Hudson Terminal building, New York, has been organized to do photo retouching and illustrating of machinery subjects.

Cammell, Laird & Co., 34 Cliff street, New York, Leonard Munns, president, Lionel Samuel, secretary, Alexander Muir, treasurer and sales manager, has been incorporated to act as general agents in the United States for Cammell, Laird & Co., Ltd., and Cyclops Steel and Iron Works, Sheffield, England.

Edgar Allen & Co., with American headquarters at 434 West Randolph street, has made agency arrangements with the following: Roehm & Davison, Detroit, Mich.; J. L. Osgood, Erie County Bank building, Buffalo, N. Y.; John J. Greer & Co., 207 West Pratt street, Baltimore, Md. Each of these concerns will carry stocks of Allen's high-speed and carbon tool steels.

INQUIRY

Wanted—Hand wheels for machine tools. Address Inquiry Department, AMERICAN MACHINIST.

CATALOGS WANTED

Monsieur Jorry, engineer, Plancher-les-Mines, Haute Saone, France, would like catalogs and information concerning equipment for a bolt and nut factory.

The R. Bliss Manufacturing Company, Pawtucket, R. I., manufacturer of wood and paper toys and wooden hardware, wishes uptodate catalogs and circulars of all kinds of metal and woodworking machinery, tools and appliances.

TRADE CATALOGS

Colburn Machine Tool Company, Franklin, Penn. Bulletin No. 43. 24-inch heavy-duty drill press. Illustrated.

The Bristol Company, Waterbury, Conn. Bulletin No. 130. Electric pyrometers. Illustrated, 56 pages, 8x10½ inches.

The Bantam Anti-Friction Company, Bantam, Conn. Ball and roller bearings. Illustrated, 38 pages, 6x9 inches, paper.

The Triumph Electric Company, Cincinnati, Ohio. Bulletin No. 441. Three-wire generators. Illustrated, 8 pages, 7x10 inches.

The Carlyle Johnson Machine Company, Manchester, Conn. Catalog E. Friction clutches. Illustrated, 35 pages, 4½x7 inches.

The Hill Clutch Company, Cleveland, Ohio. Catalog No. 9. Power-transmission machinery. Illustrated, 194 pages, 6x9 inches, cloth.

The Skinner Chuck Company, New Britain, Conn. Catalog. Lathe, drill and planer chucks. Illustrated, 48 pages, 4x7 inches, paper.

The Heald Machine Company, Worcester, Mass. Pamphlet. "Cylinder Grinding," by James N. Heald. Illustrated, 48 pages, 3½x6 inches.

Henry Disston & Sons, Inc., Philadelphia, Penn. Catalog. Saws, files, swages, machine knives, trowels, etc. Illustrated, 206 pages, 7x10½ inches, cloth.

The Hess-Bright Manufacturing Company, Twenty-first street and Fairmont avenue, Philadelphia, Penn. Catalog. HB-DWF ball bearings. Illustrated, 64 pages, 9x12 inches, paper.

The Garvin Machine Company, Spring and Varick streets, New York. Circular No. 142. Vertical spindle milling machines. Illustrated. Circular No. 143. No. 3 duplex milling machines. Illustrated.

Ingersoll-Rand Company, 11 Broadway, New York. Pamphlet No. 3007. PB duplex power driven air compressors. Illustrated, 24 pages, 6x9 inches. Pamphlet No. 5003. Radialaxe air driven coal cutters. Illustrated, 20 pages, 6x9 inches. Pamphlet No. 9008. Pneumatic tamping machines. Illustrated, 12 pages, 6x9 inches.

FORTHCOMING MEETINGS

National Metal Trades Association, annual meeting, April 14, 1911, New York City, Hotel Astor. Robert Wust, commissioner, New England building, Cleveland, Ohio.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl Street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

MISCELLANEOUS WANTS

Caliper catalog free. E.G.Smith, Columbia, Pa.

B. Jahn, New Britain, Conn., makes dies, tools, specialties and stampings.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery designed; drafting, tests, reports. Reliance Eng. Co., 113 Beekman street, New York City.

Have profitable machine shop patent, wish to manufacture. Investors write, W. N. Mesick, 1 Bradford St., Albany, N. Y.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

The Brunswick Refrigerating Co., of New Brunswick, N. J., are prepared to take on one or more manufacturing propositions.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Wanted—An article to manufacture suitable for the railway, automobile or hardware

trade; must be patented and exclusive. Address Box 356, AMERICAN MACHINIST.

Tools, dies, jigs and light and medium weight machinery designed and built to order; duplicate parts, either machined or die cast. Precision Die Casting Co., Syracuse, N. Y.

Wanted—Catalogs and information of every kind concerning equipment for a factory of bolts and nuts. Manufacturers please reply to Monsieur Jorry, Ingénieur, Plancher-les-Mines, Haute Saone, France.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Manufacturer of telegraph machines, adding machines, taxameters, accurate interchangeable parts, dies and special tools, invites orders for similar special manufacturing. The Universal Telegraphic Company, Successors to the Rowland Telegraphic Company, Baltimore, Md.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, in the Hallenbeck Building, 497-505 Pearl St., Borough of Manhattan, New York City, N. Y., on Tuesday, January 31, 1911, at 12 o'clock noon. Dated, New York City, December 9, 1910. Robert McKean, secretary.

HELP WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Good bright man to take charge of milling department in factory making interchangeable parts, such as adding machine and typewriter parts. Box 366, AM. MACH.

ILLINOIS

Wanted—Foreman machinist for shop employing about twenty men, manufacturing special and woodworking machinery, in old established business in Chicago; one with technical education and some inventive ability preferred; can acquire interest in business if desired; state experience and full particulars; all replies confidential. Address AMERICAN MACHINIST, Z 21, 150 Michigan Ave., Chicago.

A growing Chicago concern making electrical specialties, has an opening for a superintendent who is a finished mechanic, capable of taking complete charge of shop and taking the initiative; man who qualifies will be given an opportunity to become financially interested; must be steady, ambitious and have executive ability, for such this is an exceptional chance; state age, experience, present employment (time), salary; strictly confidential. Box 362, AMER. MACHINIST.

IOWA

Wanted—Draftsman, experienced in designing dies for heavy machine work; prefer one acquainted with hydraulic machinery. Box 357, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A first class designer to work on line of grinding machinery; state age, experience and salary expected. Box 371, AM. MA.

Wanted—Machinery or hardware salesman to sell cast bronze name plates on commission as a side line. Murdock-Reed Co., 127 Federal St., Boston, Mass.

MICHIGAN

Wanted—At Jackson, Mich., draftsman, experienced on axle, transmission and general gear work; state full particulars in first letter. Box 361, AMERICAN MACHINIST.

MINNESOTA

Wanted—Cream separator, bowl balancers; good position; answer immediately. Box 375, AMERICAN MACHINIST.

NEW YORK

Wanted—Mechanical draftsman, who has had experience in designing woodworking machinery; A-1 man required; state age, experience and reference. Box 365, AM. MACH.

Agent wanted in the United States of America for sale of first class electrical hand, boring machines, which are not yet manufactured in America. Box 372, AM. MACH.

Wanted—First class screw machine hands, lathe hands, milling machine hands and draftsmen, experience in automobile work; good wages, steady positions. Apply by letter. Maxwell-Briscoe Motor Co., Employment Bureau, Tarrytown, N. Y.

Wanted—A builder to manufacture roller and ball bearings in quantity; these bearings are entirely frictionless and require no lubrication of any kind; they have been thoroughly tested on the most trying work; will give five-year contract. "Oilless," Box 355, AMERICAN MACHINIST.

High speed steel demonstrator and salesman wanted by a well known house for a brand of high speed and carbon steels, long established and extensively used; competent man with an acquaintance in New Jersey, Delaware, eastern Pennsylvania, etc., preferred; give full particulars, including age and salary expected. Box 367, AM. MACH.

OHIO

Wanted—Experienced man capable of taking full charge of assembling automobile engines; give age, experience and salary. Box 323, AMERICAN MACHINIST.

Wanted—An assistant machine shop foreman by a company manufacturing steam and gasolene engines; must be thoroughly uptodate. Box 360, AMERICAN MACHINIST.

Wanted—First class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal patternmakers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free Employment Department of the National Metal Trades Association, New England Building, Cleveland, Ohio.

PENNSYLVANIA

Several first class diemakers for accurate work. Box 342, AMERICAN MACHINIST.

Wanted—Engineer or good salesman to represent first class company; fine proposition for one who gets results; state particulars. Box 359, AMERICAN MACHINIST.

Wanted—A leading draftsman, experienced on hoisting engine work; in reply state age, experience, reference and salary expected; an excellent opportunity for a good man. Box 370, AMERICAN MACHINIST.

Assistant foreman wanted for a machine shop, for medium and heavy work; must be able to handle men and be familiar with modern machine tools to turn out work to the best advantage; permanent position for the right party; state age, experience and salary desired. Box 329, AMER. MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

VERMONT

A first class machinist and toolmaker, with experience on hand and automatic screw machines, a man capable of looking after the tools and help required on 15 to 20 machines of the Brown & Sharpe, Hartford, Pratt & Whitney and Gridley types; a married man about 40, a German preferred, who desires to settle in a small town where there are good schools and every advantage for good living; a permanent position to the right man. Box 378, AMERICAN MACHINIST

WEST VIRGINIA

Wanted—Experienced die setter to take charge stamping department of can factory; state experience, salary and present employment. Address "Die Setter," AM. MACHINIST.

Wanted—Man with considerable mechanical experience, mechanical engineer preferred, to superintend large stamping and manufacturing plant; must have fair education and executive ability; state experience and give present employment. "Stamping," AM. MACH.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

INDIANA

Grinding room foreman: five years' experience; first class reference; familiar with piece and premium system. Box 380, AM. M.

MASSACHUSETTS

Machinist, toolmaker and draftsman, wishes position as foreman with reliable parties or company where his efforts would be fully appreciated; A-1 reference. Box 382, AM. MA.

MICHIGAN

Open for engagement April 1; mechanical engineer, experienced in the design and manufacture of steam, power and centrifugal pumps. Box 373, AMERICAN MACHINIST.

A position is sought by a mechanical engineer with best of qualifications and of demonstrated inventive ability, who has had many years of practical experience in drafting, templet and patternmaking, millwrighting and designing and erecting of machinery; experienced in the minutest and most exacting as well as heavy machine work; graduate of a polytechnical school and a thorough mathematician; references furnished; initial salary not so much an object as securing an opening with a good, progressive firm. Box 376, AMERICAN MACHINIST.

NEW JERSEY

Draftsman, 20, shop two years, board three years, desires position, any line. Box 377, AMERICAN MACHINIST.

Machine shop foreman open for engagement; has a wide experience with uptodate methods; ambitious and capable; best of references. Box 381, AMERICAN MACHINIST.

Designing and construction engineer is open for a position; fainliar with the design and construction of tools, jigs, fixtures, punches and dies and subpresses, automobiles, structural steel and mill construction, machinery, etc. Box 364, AMERICAN MACHINIST.

NEW YORK

Draftsman, designer, experienced, seeks position. Box 358, AMERICAN MACHINIST.

A first class mechanical designing draftsman; special and automatic machinery, development of inventions; New York City or vicinity preferred. Box 374, AMER. MACH.

Foreman desires change, medium or heavy work; first class organizer piece work; uptodate on modern methods; electrical or general machinery; references from present employer. Box 339, AMERICAN MACHINIST.

Commercial engineer, thirty-five years old, well connected at present, is looking for more responsible position as manager, or in charge of sales or production, where field will widen from personal effort. Box 338, AM. MACH.

PENNSYLVANIA

Mechanical designer, technical education, experienced in developing inventions and automatic machinery; references. Box 368, AMERICAN MACHINIST.

Technical graduate, six years' theoretical and practical experience designing general machinery, automatic machines, structural work and plant designer, wants responsible position. Box 345, AMERICAN MACHINIST.

High grade tool designer desires change; now employed as chief tool designer; automatic and modern shop interchangeable practice; technical education; accurate, practical, progressive. Box 351, AMERICAN MACHINIST.

Mechanical engineer of sixteen years' experience, uptodate in modern shop practice, good organizer and systematizer, skilled in cost reduction and increase of output, desires position as engineer or superintendent. Box 302, AMERICAN MACHINIST.

General manager, superintendent, production specialist; over 20 years' machine shop, foundry and office experience on interchangeable system of tool, machinery and mechanical specialty manufacturing; age 37; references. Box 383, AMERICAN MACHINIST.

Young man wants position as foreman, speed boss, or inspector; has served apprenticeship and worked as machinist and toolmaker, part of time in shop run under the Taylor system; also has had two years' technical training at college and worked two years in drafting room. Philadelphia or vicinity preferred. Box 363, AMER. MACH.

OHIO

Competent designer and draftsman desires change; age 30; shop experience; western States preferred. Box 379, AMER. MACHINIST.

Man, with 20 years' experience in brass shop, 15 years as foreman of tool room, wishes to make a change; West preferred; age 38. Box 369, AMERICAN MACHINIST.

WISCONSIN

Man of good education and wide practical experience, wants position as foreman of tool job, or on experimental work. Box 307, AMERICAN MACHINIST.

FOR SALE

Boring and turning mill, modern heavy pattern, 78-inch swing, 48-inch height; used very little; will sell low to avoid handling. 36 Rapleyea St., near Hamilton Ave., Brooklyn, N. Y.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

Where does it all come from?

How do you get the information that fills the editorial columns each week?

Chiefly from two sources: Our regular traveling editorial staff and our valued contributors.

The editorial staff of the AMERICAN MACHINIST numbers seven men, each an expert in his line.

From all sections of the country they get material which shows methods and machines found in shops of all kinds, in many lines of industry, from the building of watches to locomotives, and all between.

Our list of contributors includes presidents of well-known building firms, mechanical engineers, superintendents, designers, foremen, toolmakers, draftsmen, high-grade machinists—all practical men whose experience is of value.

All published contributions are paid for.

From 30 to 40% of the contributed matter is rejected.

An article is first judged from two standpoints: its suitability for our columns and the accuracy and desirability of the matter it describes.

The returning of a manuscript does not necessarily mean that it is of no value. Sometimes similar information has recently been published, or it may not be as directly in our line as we think best, and for other reasons.

But an article is never returned on account of poor writing, spelling or grammar. Good practical ideas are wanted, regardless of the way they are expressed. Real information is what we are after—not "literachoor," as it is commonly understood.

Every practical man who has an idea to express, everyone on the firing line who is doing or knows where interesting, out-of-the-ordinary work is being done, is invited to write us.

We want kinks, suggestions, ideas—information that will make the design and construction of machinery easier and cheaper.

We don't, however, want data which the originator would object to having published. The AMERICAN MACHINIST is no place for "back-door information."

We try to present practically all sides of a subject, believing that in a "multitude of opinions there is information"—everything that enters into machine construction from the drafting room to the paint shop.

You are not interested in all of these—of course not.

But there is something of interest and real help to you in each issue of the AMERICAN MACHINIST—in both the editorial and advertising sections. And the paper is made up so you can easily find it.

And don't think the AMERICAN MACHINIST agrees with or "stands for" every opinion that is expressed in its columns. We have our own ideas, some of them pretty strong ones too, but no seven or seven hundred men have a monopoly on all the good ideas in the country. So we give the ideas and opinions of others as well as ourselves, always having in mind the greatest good to the machine-building industry as a whole.

* * *

Only reliable products can be continuously advertised.